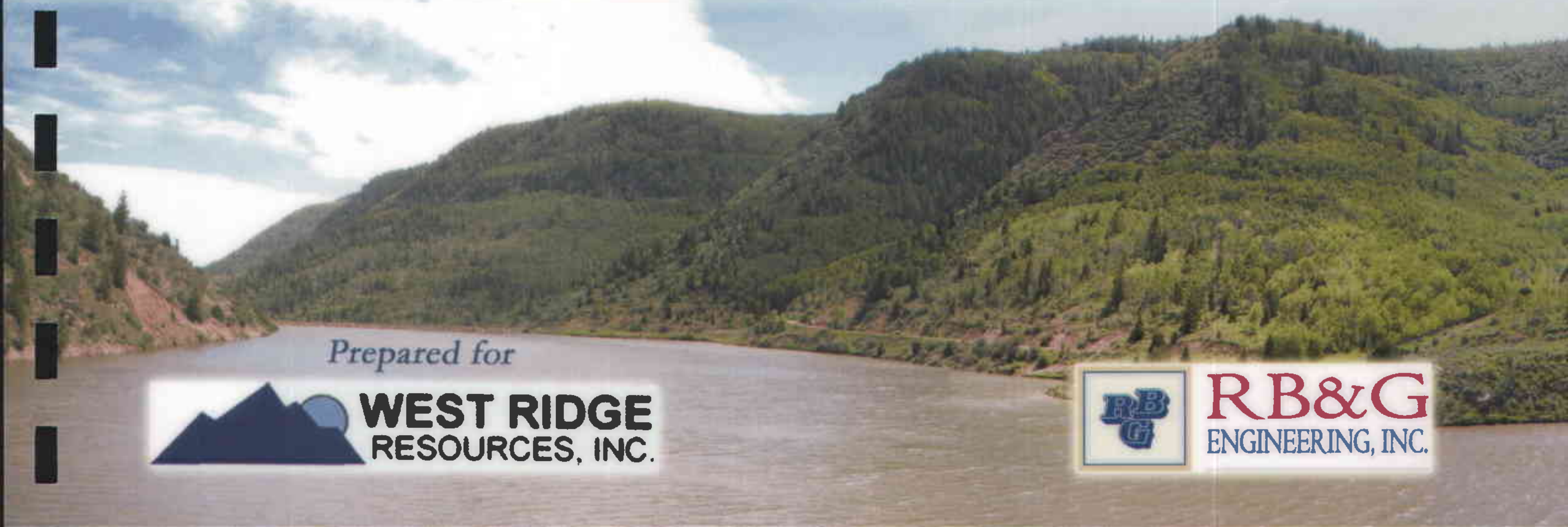
GRASSY TRAIL DAM AND RESERVOIR

MINING-INDUCED SEISMICITY

Summary Report, January 2008



Prepared for

WEST RIDGE RESOURCES, INC.

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MINING-INDUCED SEISMICITY
NEAR GRASSY TRAIL DAM AND RESERVOIR
Carbon County, Utah

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TABLE OF CONTENTS

FIGURES

APPENDICES

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ENGINEERING, INC.

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1 INTRODUCTION

This report summarizes monitoring activities conducted at Grassy Trail Dam and Reservoir primarily between the months of August 2005 and January 2008. The primary purpose of this study has been to monitor the effects of mining-induced seismicity on the dam and reservoir during and following the mining of Panel 7 in West Ridge Mine.

1.1 Background

The project area is shown on Figure 1. Grassy Trail Dam and Reservoir are located in the Book Cliff Mountains in eastern Utah, about seven miles north of Sunnyside, Utah. The dam is located in Section 7, Township 14 South, Range 14 East, Salt Lake Base and Meridian. The multi-zoned earth embankment structure was completed in 1952 and is 89 feet high, with a crest length of about 600 feet. The reservoir has a design storage capacity at the spillway crest of about 916 acre feet, and supplies culinary water to the towns of Sunnyside and East Carbon.

RB&G Engineering performed a Dam Safety Study for the owner of the Grassy Trail Dam in 1979. In 1998, RB&G Engineering provided geotechnical engineering services relating to the Phase II Dam Safety Study for Creamer & Noble Engineers, requested by the Utah State Division of Water Resources. These services included installing instrumentation (piezometers and inclinometers) to allow monitoring of the embankment.

Agapito Associates, Inc. prepared a report for West Ridge Resources in November 2004 evaluating the estimated impacts to the Grassy Trail Reservoir due to longwall mining, which included the anticipated ground deformation at or near the reservoir as the soil and the rock subsided over the mined areas.

In 2004, West Ridge Resources contracted with RB&G Engineering to provide engineering services including evaluation and monitoring of mining-induced seismicity (MIS) at Grassy Trail Dam and Reservoir. Additional instrumentation was installed to monitor ground shaking at the reservoir site. Instrumentation data obtained during mining of Panel 6 was summarized and presented in a report dated August 2005. This report included a discussion of potential impacts on the dam and reservoir during future mining of Panel 7, which was set to begin in December 2005 or January 2006. The report also provided recommendations for monitoring to be performed during mining of Panel 7.

A brief summary of the evaluations described in the August 2005 report is presented below:

- At its nearest point to the Grassy Trail Dam, the Panel 7 mining was to occur approximately 1664 feet vertically below the crest of the dam, and approximately 995 feet horizontally west of the dam's right abutment. This resulted in an anticipated minimum hypocentral (diagonal) distance of about 1939 feet between the dam and the closest point on Panel 7.
- Based on studies of mining-induced seismicity performed for the Joe's Valley/Trail Mountain area and consultation with authors of these studies (Walter Arabasz and Relu Burlacu of the University of Utah), a probable maximum magnitude of 3.9 was selected for engineering analyses. It was acknowledged that the likelihood of such an event during the mining of Panel 7 would be low, as no MIS event having a magnitude greater than 2.0 had been recorded in the area since the West Ridge Mine began operations in 2001.
- Based on a ground motion attenuation relationships developed by McGarr and Fletcher (2005) for low-magnitude, near-source mining-induced events, it was estimated that a peak ground acceleration (PGA) of 1.07g could occur at the reservoir if the probable maximum magnitude event occurred at the minimum hypocentral distance to the dam.
- Ground motions obtained from seismographs in the area were scaled to the maximum anticipated PGA value, and a Newmark Sliding Block analysis was performed to estimate potential deformation of the dam in the extreme design event. The analysis resulted in an estimated average embankment deformation of 5.4 inches, with a maximum deformation of 9.7 inches. If an additional 6 inches of

subsidence were assumed based on the Agapito report, the 7.5 feet of freeboard would only be reduced by about 1.3 feet, allowing a factor of safety of about 5.7 against overtopping following the estimated deformation and subsidence.

- For the maximum magnitude of vertical displacement described above, open joints and cracks in the embankment crest were not expected to propagate below the high water level.

- For seismic events having magnitudes less than 3.4, significant deformation of the embankment was not expected, even for events originating in the closest longwall panel. Based on the MIS history of West Ridge Mine, it was noted that mining conditions and operations did not appear conducive to event magnitudes greater than 2.0. It was recommended that mining operations be planned and executed in such a manner as to continue to minimize the magnitude of seismic events.

- Slope failures had been documented in areas above the abutments and the reservoir. These failures appeared to be shallow at the abutments, and continued movement of this type was not expected to impact the dam and reservoir, beyond minor maintenance.

- Landslide activity had been documented on the west rim of the reservoir, and the potential for further sliding was evident. An inclinometer was installed near the toe of this slide area to monitor further movement. As of August 2005, readings of this inclinometer suggested that some minor movement may have occurred since the inclinometer was installed in February 2005. It was noted that research of historic earthquake-triggered landslides indicates that earthquakes having magnitudes less than 4.0 are not likely to trigger landslides, even at epicentral distances as close as 100 meters (328 feet). It was concluded that the potential for landslide activity triggered by anticipated mining-induced seismicity is very low.

- Based upon the analyses presented in the report, it was considered unlikely that the anticipated mining-induced seismicity would impact the performance of the dam and reservoir. In order to verify the results of the analyses and protect against unforeseen conditions, it was recommended that an inspection and monitoring schedule be implemented when longwall mining activity occurs in Panel 6 and Panel 7. We recommended that the schedule include the following:

- Weekly site reconnaissance to observe any change of conditions in the embankment crest or slopes and landslide areas. Particular attention was to be given to cracking, ground deformation or seepage.
- Photographs were to be taken of areas of concern, particularly areas of slumping and seepage.
- Seepage collection and monitoring systems were to be installed and weekly measurements to begin at least one week prior to mining in Panel 7.
- Monthly measurement of inclinometers, piezometers, and ground motion monitoring devices.
- It was recommended that the instruments be sent to the manufacturer for recalibration, preferably one at a time such that one instrument would remain in operation continuously on the dam crest.
- Monthly survey of control points on the embankment and in the landslide areas. The installation and monitoring of additional settlement monuments was recommended for the dam crest, downstream slope, and toe.
- Daily monitoring of the UUSS list of recent seismic events (www.seis.utah.edu/recactivity/recent.shtml), including a daily record of the largest recorded event within 5 miles of the site.
- It was recommended that when an event greater than 3.0 occurs within 5 miles of the site, a site reconnaissance of the embankment crest, slopes and landslide areas be performed within 24 hours, along with seepage measurements and a review of ground motion recordings from the on-site instruments. If recorded ground acceleration exceeded 0.2g, instrumentation readings were to be performed as well.

1.2 Overview of Instrumentation

The locations of instrumentation used for the monitoring program are shown on Figure 2. A brief description of each type of instrumentation is provided below.

1.2.1 *Ground Motion Monitoring Devices*

Two Instantel MiniMate Plus (standard triaxial geophone) seismic monitoring instruments were first installed at the site in September 2004. Unit #BE9690 was installed on the crest of the dam. Unit #BE9698 was initially installed on the hillside approximately 900 feet west of the right (west) dam abutment, at an elevation of about 7900 feet.

The initial location of the hillside unit was selected such that the hypocentral (diagonal) distance between the unit and the nearest point mined on Panel 6 would be similar to the hypocentral distance between the right dam abutment and the nearest point to be mined on Panel 7. Following the initial monitoring during mining of Panel 6, the hillside unit was moved down the hillside to a location approximately 600 feet southwest of the right dam abutment, in order to better monitor ground motions that could affect the dam and reservoir.

It should be noted that the clocks on the ground motion monitoring devices have shown a tendency to lag behind the correct time, and have required correction after each download. The clocks have been observed to lose an average of about 4 minutes per month, which accounts for observed time differences between events recorded by the devices and University of Utah seismograph data.

1.2.2 *Inclinometers*

Four inclinometers have been installed at the site. The first three of these instruments were installed in 1998, and included one inclinometer on the dam crest near the left (east) abutment, one on the dam crest near the right (west) abutment, and one on the hillside immediately west of the right abutment. A fourth inclinometer was installed in February 2005 along the road running along the west side of the reservoir. This instrument was installed to monitor slope movements near the toe of an apparent landslide mass.

Monitoring of the inclinometers involves lowering a probe into the pipe and recording the inclination of the probe at depth intervals of two feet. The readings from each site visit can be compared to show the lateral deflection on two perpendicular axes over time.

1.2.3 Piezometers and Observation Wells

Two observation wells and five piezometers were installed in the dam in 1998. These instruments were monitored on a regular basis during the summer months between 1998 and 2005. Seven additional piezometers were installed early in 2005 to allow more thorough monitoring of seepage in the dam. In January 2006, two more piezometers were installed near the dam's right abutment. The water levels in piezometers and observation wells have generally been measured at weekly intervals since the beginning of summer of 2005.

1.2.4 Seepage Monitoring Points

Seepage monitoring points include the toe drain installed during construction of the dam, a seepage collection system constructed on the left abutment in November 2005, and a seepage collection area on the right abutment along the west side of the road. Seepage points on the dam have generally been monitored at weekly intervals since November 2005.

1.2.5 Survey Points

Survey monitoring points at the reservoir include subsidence points and instrumentation boxes on the dam itself, as well as 33 points located on the hillside west of the reservoir.

1.2.6 UUSS Data

The University of Utah Seismograph Station (UUSS) internet site has been monitored daily throughout the study. Station BCE was installed above the West Ridge Mine and began operation in August 2003.

1.3 Mining Timeline and Proximity to Reservoir

Figure 3 shows the locations of West Ridge Mine Panels 6 and 7 relative to Grassy Trail Dam and Reservoir. This figure includes the dates of completed mining for about half of Panel 6, as well as the dates that mining in each area through Panel 7 was expected to occur, as of June 2005. Figure 4 is a cross section illustrating the location of Panel 7 with respect to the dam. It will be noted that the coal seam to be mined lies 1664 feet vertically below the crest of the dam. The nearest point on Panel 7 lies 995 feet horizontally west of the dam's right abutment.

The actual dates of mining in Panel 7 (through August 7, 2006) are shown on Figure 5. The mining of this panel commenced in early December of 2005, and the shortest horizontal distance between the dam and the active mining occurred around the first week of March, 2006.

Following completion of Panel 7, the mining operation moved to a new panel located between 1.5 and 3 miles west of the reservoir (north of the previously-mined panels). The projected areas to be mined in the next five years are shown on Figure 6. From this figure, it appears that future mining will gradually progress in an easterly direction, moving closer to the reservoir. The potential future mining of panels located as close to the reservoir as Panels 6 and 7 is not projected to occur until the year 2012.

2 PRESENTATION OF MONITORING DATA

Summaries of monitoring data obtained from seismic ground motion instruments, inclinometers, piezometers, seepage monitoring points, and survey points are presented in the appendix of this report. This section discusses the apparent correlations between the mining operations at West Ridge Mine and the data collected at Grassy Trail Dam and Reservoir.

2.1 Ground Motion Monitoring Devices

The MiniMate geophones have provided monitoring of ground motions at the site since January 2005. Each instrument has been sent to the manufacturer for re-calibration twice during this time period. In each case of re-calibration, one device was left in operation while the other was being re-calibrated, to ensure that at least one device would be present at the site at all times to provide continuous data during the full duration of the study.

Tables and graphs summarizing the MiniMate data are included in Appendix A of this report. A summary of the number of events per month and the characteristics of the largest event each month is tabulated on Table A-1.

The number of seismic events recorded per day since January 2006 are plotted on Figure A-1. The number of events per day reported by the UUSS are also plotted on this figure. The figure shows that the dam and hillside seismic units recorded the most daily events during March and April 2006. The daily number of events recorded at the reservoir decreased through the summer of 2006. In contrast, the maximum number of daily earthquakes recorded by UUSS occurred in the months of July through September 2006. These trends are also illustrated on Figure A-2, which shows events per week rather than events per day.

Figure A-3 shows the number of events recorded weekly at the reservoir during 2006, as well as the approximate horizontal distance from the mining to the dam at a given time. The number of events detected at the reservoir appears to be a function of the proximity of recent mining. This figure shows that the maximum number of weekly events at the reservoir does not directly coincide with the closest distance to the ongoing mining. Instead, the period of most frequent events lags several weeks behind the period of nearest mining activity. This lag time is likely caused by the tendency of the longwall ceiling to hang up for a period of time while building up stresses sufficient to collapse a portion of the roof.

The maximum weekly peak ground acceleration values recorded at the reservoir are plotted versus time on Figure A-4. The time period during which the greatest acceleration values were recorded corresponds approximately with the time period of closest mining (February through April 2006). A maximum PGA value of almost 0.35g was recorded at the hillside instrument on March 11, 2006 during mining of Panel 7. The March 11 event had a magnitude of 2.6, which is the largest magnitude reported for the Grassy Trail and West Ridge vicinity during the 2005-2007 monitoring work. The PGA value recorded by the instrument on the dam during this event was 0.27g.

It is interesting to note that the PGA values recorded during the March 11, 2006 event were about ten times the maximum PGA value recorded during mining of Panel 6. It should also be noted that the maximum event magnitude reported during mining of Panel 6 was 2.0, while the March 11, 2006 event had a substantially larger magnitude of 2.6. It is likely that the closer proximity of Panel 7 and the larger event magnitude both contributed to the dramatic increase in peak acceleration values. Potential reasons for the larger acceleration value associated with the March 11 event are discussed in greater detail in Section 3 of this report.

2.2 Inclinometers

Figure 3 shows the location of each inclinometer. Data from the four inclinometers at the reservoir are compiled in Appendix B. A discussion of data obtained from each inclinometer is presented below.

2.2.1 Inclinometer 1

Inclinometer 1 was installed at the easterly (left) end of the dam in 1998. This inclinometer extends through approximately 48 feet of dam embankment fill and into the foundation to a total depth of about 107 feet. The positive "A" axis of this inclinometer pipe is oriented into the abutment toward the southeast, and the positive "B" axis is oriented downstream to the southwest. Deflection profiles recorded by Inclinometer 1 are shown on Figure B-1. This figure shows that the uppermost 2-foot deflection interval shows substantially greater deflections than the rest of the readings. This observation indicates only that the pipe is not rigidly confined in the soil in the upper few feet, and is not an indicator of significant ground movements.

With the exception of the uppermost point, the deflections recorded along either Inclinometer 1 axis is less than about0.2 inch. The maximum deflection was measured on July 14, 2006 and was observed to be in a northerly direction, which is contrary to most of the previous readings showing slight deflections tending to the southwest. A later measurement recorded in October 2006 showed a profile similar to those recorded prior to July 14. The October profile, along with profiles from earlier measurements, suggests that the July 14 profile is likely in error. The magnitudes of the Inclinometer 1 displacements are small, and do not exhibit a significant tendency toward instability in this area.

2.2.2 Inclinometer 2

Inclinometer 2 was installed near the west (right) end of the dam in 1998. This pipe extends to a total depth of 128 feet, including approximately 120 feet of embankment fill and underlying foundation soil before penetrating about 8 feet into sandstone bedrock. This inclinometer is oriented such that positive movement on the "A" axis indicates movement into the west abutment, and positive movement on the "B" axis is upstream toward the reservoir.

Deflection profiles for the "A" and "B" axes are shown on Figure B-2 in Appendix B. The inclinometer pipe has deflected approximately 3.5 inches in the negative "A" direction, with the large majority of this deflection having occurred between December 2005 and August 2006. The profiles also show deflection of about 0.7 inch in the positive

"B" direction to have occurred over approximately the same time period. In both cases, the profiles appear to be relatively stable since the end of the summer in 2006.

The shapes of the deflection profiles are relatively consistent for the various dates that measurements were recorded. On both axes, the deflections below a depth of 120 feet are minimal. The deflection on the "A" axis increases in an approximately linear fashion between depths of 120 and about 66 feet, with the exception of a relatively abrupt increase between depths of 114 and 112 feet. Profiles measured after summer of 2006 show a deflection difference of about 0.4 inch between depths of 114 and 112 feet. Above a depth of 66 feet, the measured deflection is relatively consistent, indicating very little relative deflection between a depth of 70 feet and the top of the dam.

The deflection on the "B" axis is somewhat abrupt between depths of 120 and 110 feet, followed by a near linear trend of gradually increasing deflections between 110 and 45 feet. Above a depth of 45 feet, the "B" axis profile is marked by a an opposite near linear trend of decreasing deflections, such that the deflection at the top of the pipe is very small (less than about 0.2 inch) relative to the bottom of the pipe. The resulting profile appears to "bulge" along the positive "B" axis, with the maximum deflection of 0.7 inch occurring at a depth of about 44 feet.

The deflected shape of Inclinometer 2 on October 28, 2006 relative to a baseline shape measured on July 20, 2004 is shown in plan view on Figure B-3. The figure shows that the measured deflections are oriented primarily along the dam axis from the west (right) abutment toward the maximum section to the east. The slight "bulging" noted on the "B" axis profile is in the upstream direction.

Figure B-4 shows deflections along the "A" axis of Inclinometer 2 plotted versus time. The blue line is a plot of relative deflection between depths of 44 and 122 feet. Lines showing deflections between depths of 66 and 120 feet, as well as the 120 to 126-foot depth interval and several shallower depth intervals, are also shown. It is apparent from the figure that the relative deflection measured along the 'A" axis was minor at depths above 44 feet and below 122 feet.

The dates on Figure B-4 can be compared to the dates at which mining occurred closest to the dam. Some lateral deflection (0.4 inch over the 44 to 122-foot depth interval) occurred during Panel 6 mining in 2005. Much of the 2005 deflection occurred during the first half of the year, and measurements after June appear to demonstrate a decreasing rate of deflection. By November 2005, the ongoing deflection appears to be negligible.

As mining commenced in Panel 7, the deflections measured in Inclinometer 2 began to increase substantially, with the greatest deflections occurring during and immediately following the period of shortest distance between the mining and the dam. By August 2006, the ongoing deflections were very small.

There appears to be a very strong correlation between the deflections measured by Inclinometer 2 and the proximity of longwall mining. The larger magnitudes of events recorded during Panel 7 mining compared to Panel 6 mining may also contribute to the larger lateral deflections observed during Panel 7 mining.

2.2.3 Inclinometer 3

Inclinometer 3 was installed in the dam's right (west) abutment in 1998. This pipe extends through about 7 feet of clayey overburden soil, underlain by predominantly mudstone to about 42 feet, and terminates after penetrating about 11 feet into sandstone at a total depth of 53 feet. The positive "A" axis of Inclinometer 3 is oriented predominantly away from the dam and 20 to 25 degrees upstream of the dam axis. The positive "B" axis is oriented predominantly upstream toward the reservoir.

Profiles of deflection measurements recorded at Inclinometer 3 are shown on Figure B-5. The deflection shape shown for the "A" axis is relatively irregular, with zones of both positive and negative deflections at varying depths. The deflections are predominantly in a positive direction below 45 feet, negative between 45 and 33 feet, positive between 33 and 20 feet, negative between 20 and 13 feet, and positive again above a depth of 13 feet.

The peak deflection in each zone is generally about 0.2 to 0.3 inch, with a maximum deflection approaching 0.5 inch at the top of the pipe.

The "B" axis shows very small deflections below a depth of about 43 feet. Above 43 feet, the deflection profile is characterized by a roughly linear increase to about 0.3 inch at the top of the pipe.

Figure B-6 is a plan view of the deflection measurements in Inclinometer 3. The predominant plane of back-and-forth lateral deflection is parallel to the dam axis, but an overall movement in the upstream direction is also apparent.

The irregular shape of the "A" axis deflection profile may be cause by compressional deformation of the pipe. An alternative explanation could be that various layers of rock are shifting independently from one another.

Figure B-7 shows the deflection for the various depth intervals plotted versus time. On this figure the trend is very similar to that shown for Inclinometer 2 on Figure B-4. Again, it appears that relatively small lateral ground movements occurred at the abutment during mining of Panel 6 in 2005, followed by larger deflections occurring during Panel 7 mining. As was the case with Inclinometer 2, the rate of deflection at Inclinometer 3 was very small during periods of limited or more distant mining activities, such as November-December 2005 and after August 2006.

The deflections measured at Inclinometer 3 are substantially smaller than those measured at Inclinometer 2; however, it should be noted that the bottom eight feet of Inclinometer 2 appear to be fixed in place, suggesting that the pipe may be anchored in a stationary stratum. By contrast, Inclinometer 3 shows deflections beginning at the deepest measurement interval (51 to 53 feet). This observation suggests that the bottom of the Inclinometer 3 pipe may not be anchored as the Inclinometer 2 pipe appears to be. The deflection measurements for this pipe could be relative to a non-stationary bottom point, and it may not be appropriate to interpret the deflections shown for Inclinometer 3 as absolute deflections.

2.2.4 *Inclinometer 4*

Inclinometer 4 was installed in February 2005 on the west rim of the reservoir upstream of the dam. This instrument is located immediately west of the roadway in the lower portion of an apparent slide mass. The pipe extends through approximately 37 feet of soil and penetrates about 30 feet into the underlying bedrock to a total depth of 67 feet. The positive "A" axis for this inclinometer is oriented in an easterly direction toward the reservoir. The positive "B" axis points downstream toward the dam.

Deflection profiles for Inclinometer 4 are shown on Figure B-8. The profile for the "A" axis exhibits a distinct down-slope displacement between the depths of 61 and 63 feet. Over time, the magnitude of this displacement has increased to approximately 0.3 inch. The maximum displacement is located at a depth of 59 to 60 feet, and the lateral displacement tends to decrease gradually coming up the pipe from that depth. This deflected shape suggests a discrete failure surface at a depth of about 62 feet, with a slight backwards rotation of the moving mass. The larger displacements shown in the upper 3 feet indicate that the top of the pipe is somewhat loose or influenced by shallow ground movement at the edge of the roadway.

The boring log recorded during installation of Inclinometer 4 shows that the bedrock above a depth of 64 feet is primarily mudstone. The log notes that clay seams were present in the mudstone core sample retrieved from a depth of about 61 to 64 feet. The log also shows sandstone below a depth of about 64 feet. Based on the boring log and the observed deflections, it appears that the slip surface is located within the mudstone layer with clay seams encountered immediately above the sandstone.

The "B" axis of Inclinometer 4 shows relatively small displacements, with the exception of the near-surface deflections in the upper 3 to 4 feet. The pipe appears to be anchored and stationary from depths of 79 to 63 feet, with a slight discrete deflection in the downstream direction between 63 and 61 feet. This deflection tends to reverse to the upstream direction between 41 and 43 feet. The deflections on the "B" axis tend to go back and forth over time, and it is possible that the deflections shown are of a small enough magnitude to be within the accuracy limits of the instrument.

Figure B-9 shows a plan view of the Inclinometer 4 deflection measurements. Disregarding the outlying points at depths of 1 and 3 feet, the deflection is predominantly eastward down the slope and into the reservoir, as would be expected.

The deflection of Inclinometer 4 along the "A" axis is plotted versus time on Figure B-10. The same trend observed at Inclinometers 2 and 3 is also apparent at Inclinometer 4. One notable difference is that the deflections attributable to mining of Panel 7 appear to subside several months earlier (around June 2006) at Inclinometer 4, while they continue until about August in the west abutment area of the dam. The approximate zones of mining during which the most significant deflections occurred at Inclinometers 2, 3, and 4 are shown on Figure B-11. This different influence zone for Inclinometer 4 suggests that the slide mass monitored by Inclinometer 4 may be less sensitive than the west abutment area to smaller ground motions originating at a greater distance. Another possible explanation is that the displacements measured prior to June 2006 may have moved the slide mass into a more stable position, thereby increasing the threshold level for ground motions to cause significant displacements.

2.3 Piezometers and Observation Wells

The dam has been heavily instrumented with piezometers and observation wells to allow careful monitoring of any changes in seepage behavior. The locations of these instruments are illustrated on Figure 3, and the piezometer and well readings are summarized in Appendix C of this report.

As noted previously in this report, Observation Wells 1 and 4 and Piezometers 2, 3, 5, 6, and 7 were all installed in 1998. During the initial Mining-Induced Seismicity study (2005), it was noted that the historical readings from at least one of these instruments (Observation Well 1) were very erratic. Piezometers 8 through 14 were installed early in 2005 to verify the readings of the existing instruments and to allow monitoring at a greater number of locations and depths. After mining of Panel 7 was completed and inclinometers showed evidence of displacement at the west (right) abutment, Piezometers 15 and 16 were installed at the right abutment to more closely monitor seepage at that location. It should be noted that some piezometer locations have two piezometer tips, with one tip located below the dam in the foundation material, and a shallower tip located within the embankment.

The water elevation in each piezometer is plotted versus time on Figure C-1. The tip elevation for each instrument is marked at the beginning of the plot. The water elevation in the reservoir on the date of each reading is also shown on this figure. From 1998 to 2004, water level measurements were generally recorded frequently during the summer months but very infrequently during the winter. As would be expected, the water level in the reservoir is typically at its highest in the spring of each year, with a slight drawdown occurring over the summer and into the fall months. It is notable that the reservoir is generally drawn down only 6 to 12 feet below the spillway elevation in the course of a year.

Figure C-1 shows that the water levels in the piezometers and observation wells generally rise and fall with the water elevation in the reservoir. The one exception is Observation Well 1 (OB-1), which had very erratic measurements from 1998 and 2004. Some effort was made to flush out this well in 2005. Readings since that time have been substantially less erratic, but still more irregular than those of the other instruments.

The general consistency of the water level readings, with seasonal fluctuations corresponding to the reservoir level, is indicative of consistent seepage conditions within the dam and foundation. No substantial or unusual changes in these water levels have been noted, despite the lateral displacements indicated by the inclinometers at the west abutment.

2.4 Seepage Monitoring Points

Seepage through the dam, foundation, and abutments is collected at three locations, including the toe drain connected to the dam's internal drainage system, a seepage collection system located on the east (left) abutment, and a collection pipe located on the west (right) abutment. The flows from the drains are measured by recording the time to fill a container of known volume with water from each collection point. The clarity of the water has also been recorded during seepage readings. Clear seepage water indicates that the flow is adequately filtered and is not moving material through the dam or foundation. Cloudy seepage water could be a sign of internal erosion, which could lead to a piping-related failure of the structure.

The seepage flows from each drain are plotted along with the water surface elevation on Figure C-2 in Appendix C. From the figure it is apparent that the reservoir surface fluctuated between about elevation 7586 feet in the winter months to about elevation 7592.5 feet in the summer months in 2006 and 2007. The seepage rates measured at the drains appear to correlate with the reservoir water level, with the greater flows occurring during periods of higher water elevations in the reservoir.

The greatest flows were measured at the left abutment. The left abutment seepage collection system was constructed in November 2005 to collect water that was seeping through the left abutment and causing some instability of the overburden soils in this area. The seepage from this drain generally varied between about 10 and 20 gallons per minute.

The water in these drains was generally frozen in the winter months, and negligible flows were noted at these times. Flow rates ranging from about 2 to 6 gallons per minute were typically recorded during warmer periods.

2.5 Survey Points

West Ridge Mine contracted with Ware Surveying to provide surveys of points on the dam and the slopes west of the reservoir at various times throughout the monitoring program. The intent of these surveys has been to monitor movements of the slide areas and to verify that significant movements of the dam itself do not occur. Data obtained from the surveys is summarized in Appendix D of this report.

2.5.1 Survey Points on Hillside West of Reservoir

Figure D-1 shows the survey points located on the hillside slopes west of the reservoir. Points 1 through 14 form a rough line down the hillside in the slide area above the dam. Points 30 through 49 form a similar line for tracking movements of the hillside near the upper end of the reservoir. The coordinates surveyed for each point on six dates between September 2004 and May 2007 are shown on Table D-1.

The changes in the surveyed northing, easting and elevation coordinates for points 1 through 14 are plotted on Figures D-2a, D-2b, and D-2c, respectively. It will be noted from Figure D-2a that the uppermost points (Points 1 through 8) do not exhibit a clear trend of displacement in any particular direction. Point 1 shows a northerly displacement greater than one foot in the August 2005 survey, but returns to very near its original position in the following survey. The displacement of Point 1 shown in August 2005 is likely an error in the survey or in data tabulation.

The lower points on the hillside above the dam (Points 9 through 14) appear to have undergone northerly displacements in the order of 0.25 to 0.5 foot during the 2006 mining work. Figure D-2b shows that all of the points in the group above the dam experienced easterly displacements of about 0.6 to 1.2 feet during this same time period. Figure D-2c shows the same trend, with the elevations of the points decreasing by about 0.5 to 1.8 feet between August 2005 and October 2006. The change in elevations was more pronounced at the uppermost points, and generally decreased at points closer to the dam. All coordinates show substantially less movement during the last survey interval (October 2006 to May 2007) after mining of Panel 7 was essentially complete.

The changes in the surveyed northing, easting, and elevation coordinates for Points 30 through 49 are plotted on Figures D-3a, D-3b, and D-3c. The northing coordinates of these points show a tendency to move south during 2005 and into April of 2006, followed by a more northerly motion between April and October 2006. The changes in the northing coordinates are less than 0.5 foot. The easting coordinates are relatively stable until the April to October 2006 interval, at which time most of these coordinates show an eastward shift ranging from about 0.4 to 0.7 feet. It is noted that the two lowest points on the slope (44 and 45) moved very little over this time interval, suggesting that the activated slide mass ends somewhere between points 43 and 44.

The elevations of points 30 through 49 show a general trend of downward displacement between December 2004 and October 2006, with the greatest movements typically measured over the last six months of this period. The total change in elevation coordinates ranged from almost a foot at the upper end of the group to less than 0.2 foot at the lower end. As was the case with Points 1 through 30, the coordinates of Points 30 through 49 show very little movement between October 2006 and May 2007, after mining of Panel 7 was complete.

2.5.2 Straight-Line Survey of Dam Crest

Appendix D also contains a description of straight-line surveys performed by Ware Surveying at the request of the mine (See Exhibit D-1). This survey work involved setting a monument on the east dam abutment to line up with a number of the instrumentation covers along the dam crest. Between May and December 2006, this line was surveyed at least monthly (more frequently between May 26 and August 11) to verify that none of the points on the dam crest moved downstream or upstream relative to the benchmark and the other points.

Beginning in December 2006, the horizontal distance from the benchmark to each of the points was also surveyed to check for displacements along the dam crest parallel to the dam's longitudinal axis. This straight-line survey effort has continued at approximately monthly intervals since that time. The locations of the straight-line survey points are identified with the prefix "MW" on Figure D-4 in Appendix D. A summary of surveyed distances through October 2007 is shown on Table D-2. No noticeable transverse movement has been identified over the time period that the straight-line survey has been performed. No significant longitudinal movement along the dam axis has been measured since the distance measurements were first recorded in December of 2006.

2.5.3 Settlement Monitoring Points on Dam Crest

The points labeled with the prefix "C" on Figure D-4 are settlement monuments embedded in the crest of the dam. The elevations of each of these points have been measured over time using a differential level survey. Surveys were performed once each year between July 2002 and August 2005. Four surveys of these points were performed between March 21 and May 30, 2006, when mining was occurring near the dam in Panel 7. Additional surveys were performed in August and September, 2006, and in October 2007.

The surveyed elevations of the monuments on the dam crest are tabulated on Table D-3 in Appendix D, and the differences in elevation using the July 2002 survey as a baseline are plotted on Figure D-5. This figure shows that most of the elevation differences were less than 0.05 foot. The points located on the westerly half of the dam (C-1, C-2, C-3, and C-4) nearest the mining activities appear to have undergone some vertical displacement. Slight upward displacements are evident during mining of Panel 6 in 2005, with more significant displacements noted during mining of Panel 7 in 2006. The points on the easterly half of the dam (C-5, C-6, and C-7) appear to have undergone very little vertical displacement during the survey period.

Of particular interest is the 0.2-foot (2.4-inch) vertical displacement measured at point C-2. Most of this displacement was measured during mining of Panel 7. Point C-2 is located near Inclinometer 2, which measured approximately 3.5 inches of lateral displacement toward the maximum section of the dam. It would appear based on these data that the west end of the dam was pushed slightly upward and to the east as mining was performed near the dam.

3 SUMMARY AND CONCLUSIONS

This section provides a brief summary of the findings of the monitoring data described in the previous section, and presents several conclusions that may be drawn based on this data. It should be noted that mining in the West Ridge Mine continues to occur, along with regular monitoring of impacts at the reservoir site. The current mining is at a much larger distance from the dam than Panels 6 and 7, but the distance between the reservoir and active mining areas is expected to decrease over the next several years. Data collected during this future mining will likely lead to some refinement of the conclusions presented below.

3.1 Mining-Induced Ground Motions at Grassy Trail Reservoir

The longwall mining operation performed in Panels 6 and 7 resulted in ground motions detected on the hillside west of the dam, as well as on the crest of the dam itself. The recorded mining-induced ground accelerations at the dam were relatively small during mining of Panel 6, and increased substantially during mining of Panel 7. The number of mining-induced events detected by instrumentation at the reservoir also increased substantially during Panel 7 mining. The increase in the number of events and the recorded acceleration levels appears to be strongly connected to the increased proximity of mining. There appears to be a lag of a few weeks up to several months between the time period of closest-proximity mining and the time of maximum mining-induced ground motions at the reservoir.

It was also noted that the earthquake magnitudes reported by the University of Utah during mining of Panel 7 were substantially larger (up to a magnitude of 2.6) than those reported during the mining of Panel 6 (maximum magnitude of 2.0). During a review meeting following the mining of Panel 7, it was suggested that as adjacent panels are mined, the potential area that can collapse at a given time becomes larger. When a panel is mined adjacent a previously mined panel, there is potential for collapse in both the first and second panels, increasing the width of mined area that could collapse at a given time. Collapse of a wider area would release more energy and be detected as a larger-magnitude event.

The larger area of mined space may have contributed to the larger events recorded during Panel 7 mining. The increase in event magnitudes from Panel 6 to Panel 7 may also be related to variations in cover depth, geologic features, mining practices, lag time in collapse of the mine roof behind the longwall operation, and/or other factors. It is interesting to note that, according to the Panel 7 mining dates shown on Figure 5, the distance mined during February 2006 was only about 75 percent of the distances mined in both January and March 2006. The apparent change in the rate of mining may have somehow contributed to the larger magnitude event reported on March 11. The slower mining rate in February could also indicate the presence of a geologic anomaly that may have affected the event magnitudes in this area. Determining the most likely causes of the larger-magnitude events during Panel 7 mining is beyond the scope of this report; however, the increased event magnitudes undoubtedly contributed to the larger ground motion values recorded at the dam site.

The August 2005 Mining-Induced Seismicity Study used an attenuation relationship developed by McGarr and Fletcher (2004) to estimate the potential range of ground accelerations for mining-induced events near Grassy Trail Reservoir. The March 11, 2006 event of magnitude 2.6 was likely caused by collapse of the mine ceiling over the area mined in the previous weeks and months. It is our understanding that the area of Panel 7 nearest the dam was mined in February and March of 2006. The estimated hypocentral distance from the nearest mined area to the hillside ground motion instrument during this time ranges from about 1700 to 2200 feet. For a magnitude 2.6 event occurring within this range of distances, the McGarr-Fletcher equation predicts peak ground accelerations in the order of 0.05 to 0.1g.

For the March 11, 2005 event, the McGarr-Fletcher relationship under predicts the recorded ground motion at the dam site by a factor ranging from 3 to 7. This discrepancy does not necessarily indicate that the attenuation equation is not a useful tool for predicting ground motions at the West Ridge / Grassy Trail site. In fact, McGarr and Fletcher noted that only 68% of the peak acceleration data from which the equation was developed were within a factor of 3 of the values predicted by the equation. Considering the scatter in the Trail Mountain data used to develop the equation, along with the differences in conditions at Trail Mountain compared to conditions at West Ridge, the under prediction of the March 11, 2006 acceleration value is not surprising. However, this case does underscore the importance of using caution and judgment in any efforts to predict ground motions.

3.2 Permanent Ground Deformations at Grassy Trail Reservoir

3.2.1 Grassy Trail Dam Embankment and Abutments

The inclinometer located at the left (east) abutment did not show substantial deflections as a result of the mining-induced ground motions. The inclinometers at the right (west) abutment did measure deflections. Inclinometer 2 extends through the embankment and into the foundation, and lateral deflection of up to 3.5 inches has been recorded in a direction parallel to the dam axis moving away from the west abutment. The 3.5-inch deflection does not occur at a discrete depth as would be expected where a defined failure surface exists. Instead, the deflection occurs gradually between depths of about 120 and 66 feet. Inclinometer 3 is located in the west abutment and shows both positive and negative deflections in different depth zones. The maximum deflection magnitude measured in this inclinometer is about 0.4 inch. The unusual deflection profile may be indicative of compressional forces on the inclinometer pipe. It is possible that the bottom of this pipe is not fixed into stationary material, and the actual deflections may be substantially different than the deflections relative to the bottom of the pipe as shown on the inclinometer profiles.

Both Inclinometers 2 and 3 exhibited some deflection during mining of Panel 6, with the deflection rate decreasing as mining moved farther away to the north and west of the dam. Deflection rates near the end of Panel 6 mining (Nov-Dec 2005) were minimal. The deflections began to increase as mining began in Panel 7, with the peak deflection rates occurring in the weeks and months following mining at the closest distance from the dam. The deflection rate decreased substantially as mining in Panel 7 moved away from the dam in the latter part of 2006; however, there is some evidence of very slight deformations continuing into the following year.

The displacements measured at Inclinometers 2 and 3 are predominantly directed along the dam axis toward the maximum section of the dam. The earthfill dam embankment has a buttressing effect on motions in this direction, and deflections in this direction are of somewhat less concern, with respect to embankment stability, than deflections indicating movement perpendicular to the dam axis.

Settlement monument C-2, near the west end of the dam, showed slight signs of upward movement during Panel 6 mining, followed by more significant upward movement during mining of Panel 7. The monument elevation has increased about 2.4 inches. This observation, along with the observed lateral movement of 3.5 inches, suggest that movement in the west abutment area has pushed the west abutment several inches upward and toward the east.

The straight-line survey work conducted beginning in May 2006 has reported no evidence of lateral movement of the dam crest in an upstream or downstream direction. The surveys of horizontal distances along the dam crest have not shown significant longitudinal movement along the dam crest since these distances were first surveyed in December 2006.

Concern has been expressed that the lateral movements measured along the dam axis at the left abutment may result in zones of tensional forces having a tendency to open up internal cracks in the dam and/or foundation. This is a valid concern, as seepage through such cracks could cause internal erosion and further open the cracks, resulting in progressively larger seepage through the dam and potential piping-type failure.

Several factors help diminish the likelihood of increased internal erosion developing in the areas of recorded lateral deformations. As noted in the August 2005 Mining-Induced Seismicity Report, the dam embankment materials are predominantly lean clay, clayey sand, and clayey gravel, and our investigations have found that the soils in the outer downstream zone are similar to those in the central core of the dam. The foundation soils also contain significant percentages of clay and silt, and the near-surface bedrock is predominantly shale with some weathered sandstone. The clayey embankment and foundation soils, as well as the shale bedrock, have self-healing characteristic. Small cracks in these materials tend to fill in with the surrounding material, reducing the potential for piping through such cracks. The cumulative deflection measured in Inclinometer 2 appears to occur gradually over a significant depth interval (about 50 to 60 feet), suggesting that tensile strains and resulting cracks at a given depth would be relatively small despite the cumulative deflection being of considerable magnitude.

The piezometer and drain measurements to date have not shown evidence of changes in seepage behavior through the dam, including the west abutment area. The water in the drains has been clear, and no reports of cloudy or discolored water indicative of internal erosion have been made. The dam appears to have performed well to date despite the measured lateral movement at the west abutment, and the dam and foundation materials are somewhat resistant to piping through small tensile cracks. Continued monitoring will be critical to verifying the long-term performance of the dam, and recommendations for future monitoring are outlined in Section 4 of this report.

3.2.2 Slide Areas on Hillside West of Reservoir

Inclinometer 4, located upstream of the dam on the west rim of the reservoir, has shown discrete deflections of up to 0.3 inch at a depth of about 62 feet below the ground surface. Very slight deflections were measured at this depth during mining of Panel 6, but the large majority of this deflection occurred between February and June of 2006, when mining in Panel 7 was closest to the inclinometer. Measurements recorded since June 2006 suggest that this slide area has been much more stable since that time.

Points surveyed on the hillside west of the reservoir indicated substantial downslope movement (approaching 2 feet at some locations) during mining of Panel 7. These areas appeared to experience much less movement once mining of Panel 7 moved well away from the dam. These slides may become more active as future mining activities approach the reservoir and mining-induced ground motions again increase at the site. It should also be noted that increases in slide movement could occur due to other factors – such as above-average precipitation and changes in the moisture conditions in the hillside – that are entirely unrelated to the mining activities.

4 RECOMMENDATIONS

It is apparent from the data collected that mining activities in West Ridge Mine have caused mining-induced seismic events, and that ground motions caused by these events are detectable at Grassy Trail Dam and Reservoir. These ground motions have caused some measurable permanent deformations of the ground surface on the hillside west of the reservoir, as well as lateral deformations at the west end of the dam. Despite the recorded deformations, the dam appears to be performing well, and ongoing deformations have been very small since mining of Panel 7 concluded in the fall of 2006.

The inclinometers suggest that slight deformations (creep) may be ongoing at the dam's west abutment. Continued monitoring of these inclinometers is recommended to verify that the rate of this movement does not increase. Regular monitoring of piezometers and seepage collection points is also recommended to verify that the recorded lateral movements do not result in increased seepage and/or internal erosion of the dam. This monitoring is critical to ensure adequate long-term performance of the dam and the safety of people and facilities located downstream.

A meeting was held in November 2006 to review the data collected during the mining of Panel 7. The monitoring schedule developed in this meeting is included for reference as Exhibit E-1 in Appendix E of this report.

A meeting was held in October 2007 with representatives of the Utah State Dam Safety Office, the Bureau of Land Manage, the Utah Division of Oil, Gas, and Mining, East Carbon City, Sunnyside, City, West Ridge Mine, RB&G Engineering, and others in attendance. Based on this meeting and subsequent communication between the State Dam Safety Office, West Ridge Mine, and RB&G Engineering, the monitoring schedule included as Exhibit E-2 in Appendix E of this report was adopted until further notice. It is anticipated that the parties involved will meet yearly while mining continues, in order to review the monitoring data and update the monitoring schedule as needed. The frequency of monitoring may be increased at any time as dictated by unexpected changes in the monitoring data.

As noted in Exhibit E-2 in Appendix E, we will continue to perform daily reviews of the data on the UUSS web site. If an event of magnitude greater than 3.0 is reported within 5 miles of the dam, thorough site reconnaissance and reading of the ground motion instruments will be performed within 24 hours. Reading of all other instrumentation (inclinometers and piezometers) will also be performed if any recorded ground acceleration exceeds 0.2g.

The data collected to date can increase our understanding of the effects of mining-induced seismicity, and continued monitoring will supplement this database. Detailed reviews and analyses of these data may be performed to develop predictive relationships for use in future studies and planning. In particular, the data recorded at Grassy Trail Reservoir can be compared to the McGarr-Fletcher attenuation relationship that was developed based primarily on mining in the vicinity of Joe's Valley Reservoir. Refinement of the McGarr-Fletcher relationship may be possible, or a different site-specific relationship could be developed for the West Ridge / Grassy Trail location. In any case, it should be noted that the accelerations recorded at a given location are likely a function of many unknown and/or poorly understood site-specific factors, and attenuation relationships should be used to predict ground motions only with a great deal of caution and judgment.

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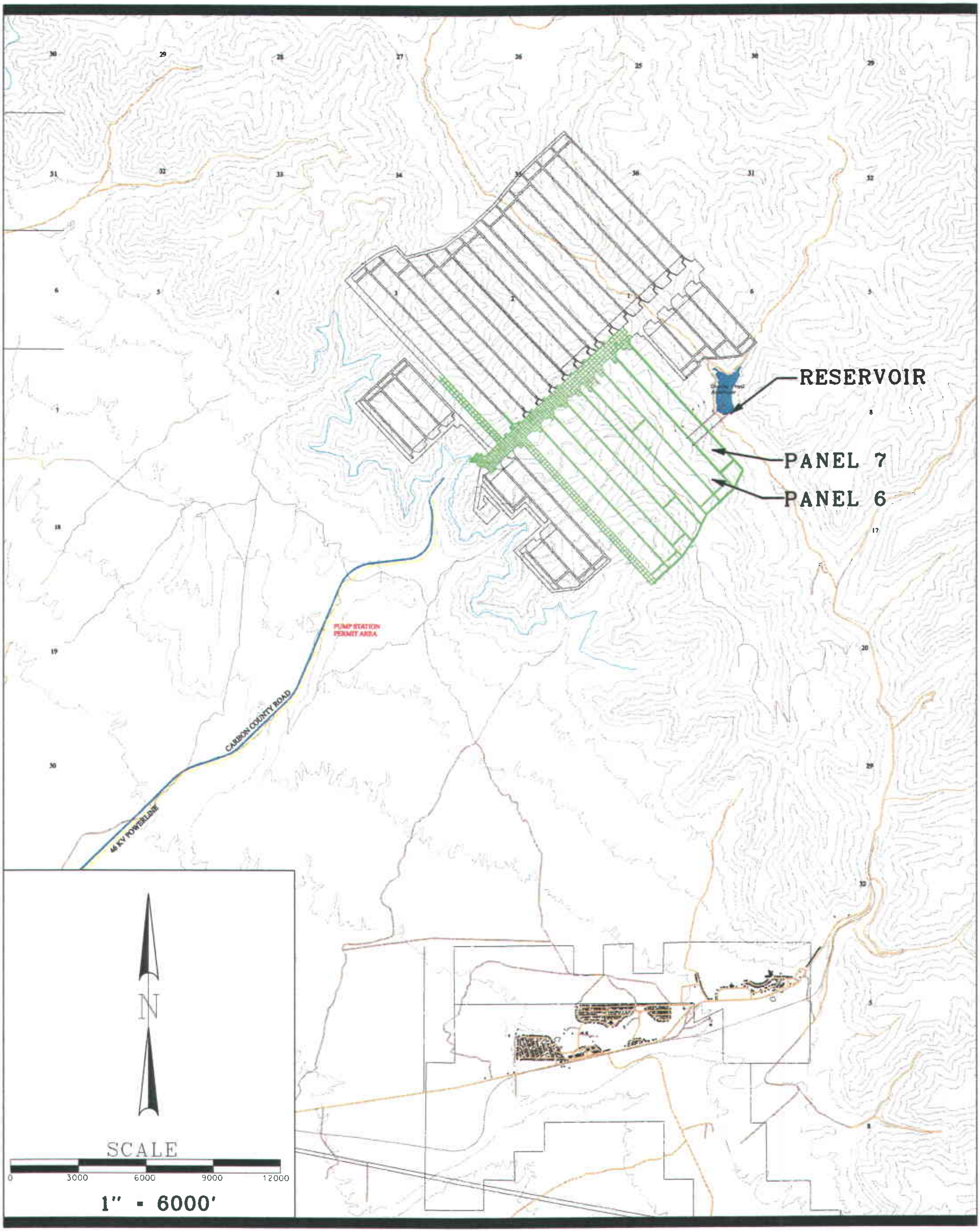

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Figure 1

WEST RIDGE MINE
PROJECT AREA

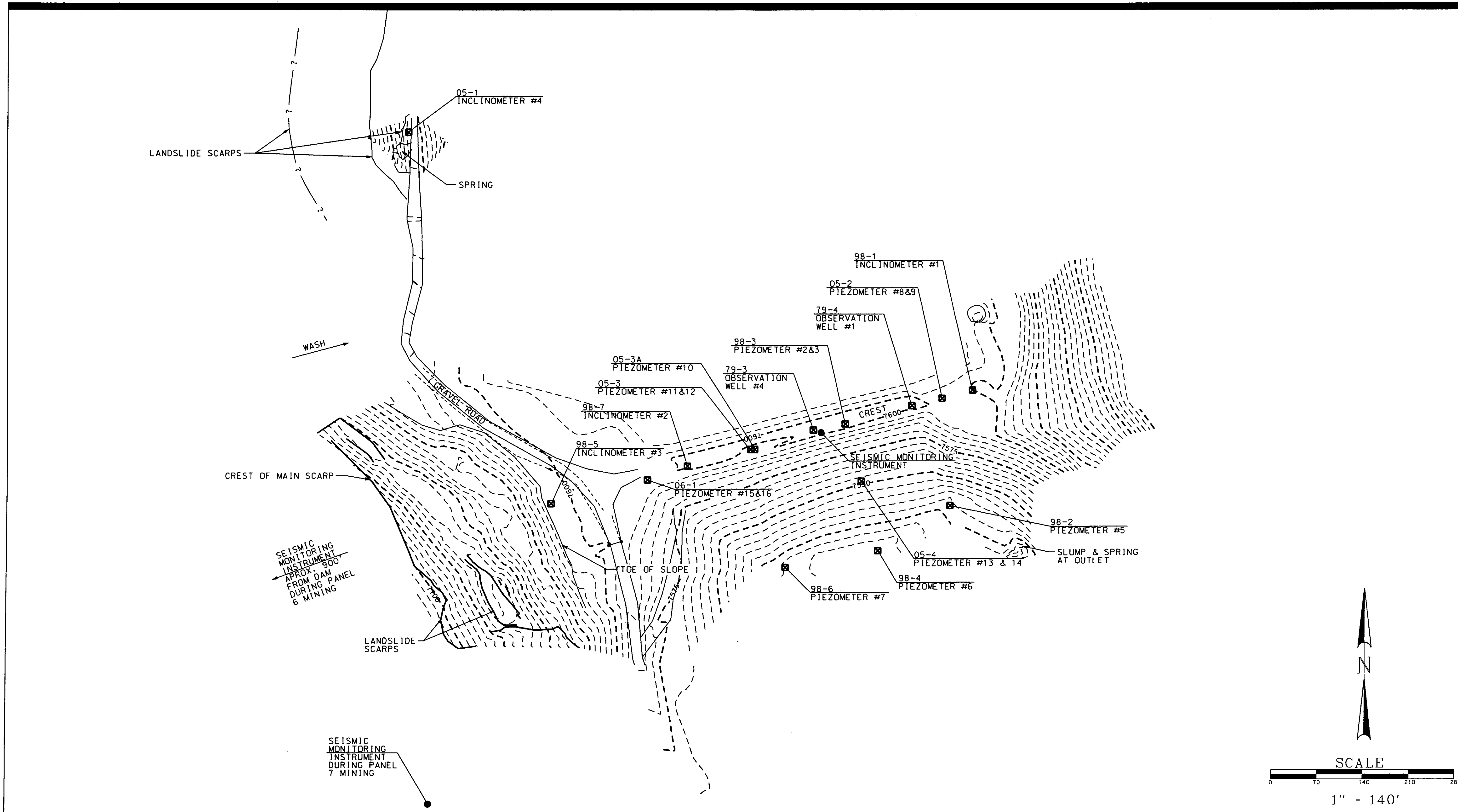

Figure 2

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GRASSY TRAIL DAM
CARBON COUNTY, UTAH

LOCATION OF INSTRUMENTATION

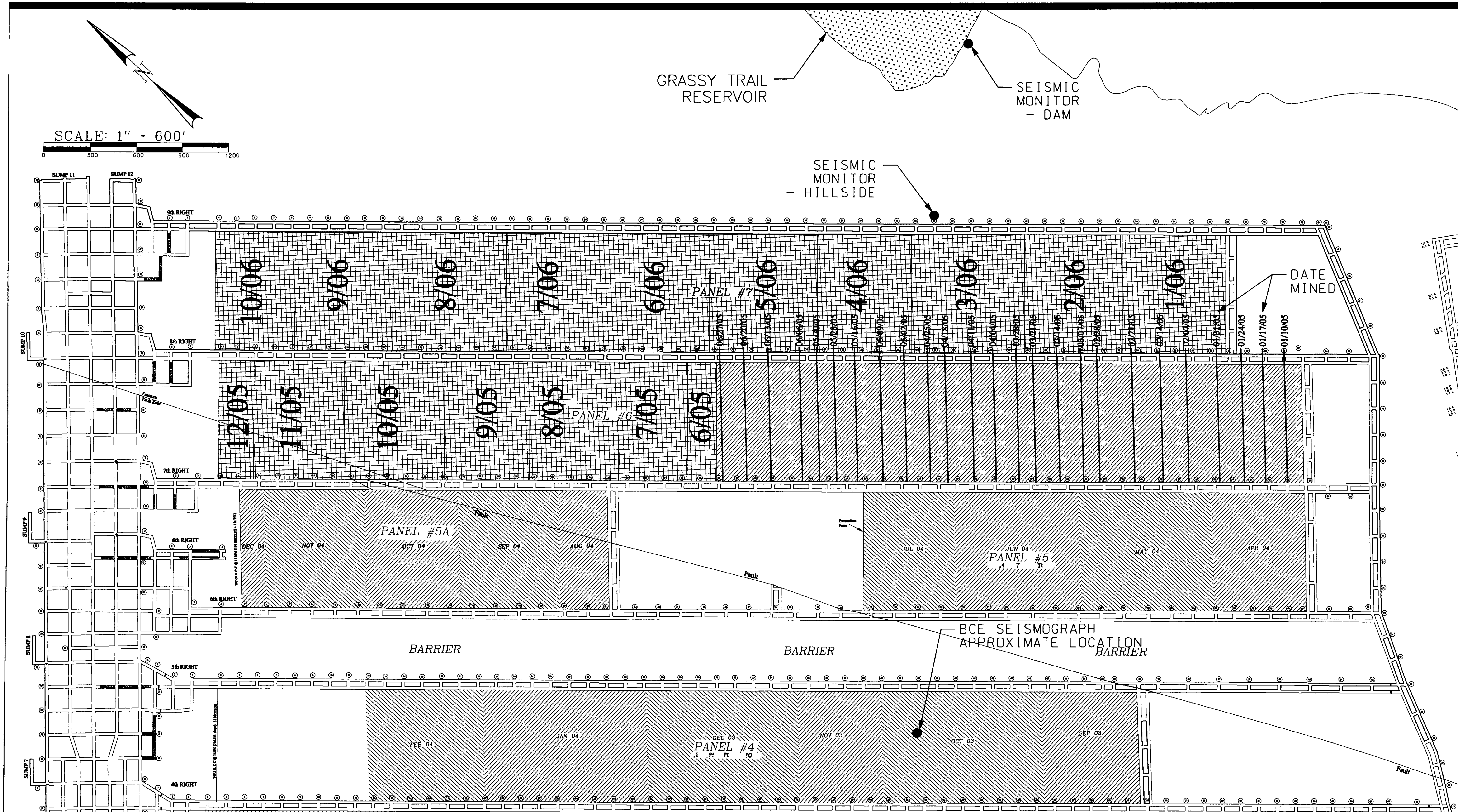

Figure 3

RB&G ENGINEERING INC.
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GRASSY TRAIL DAM
CARBON COUNTY, UTAH

PROJECTED DATES OF MINING
(AS OF JUNE 2005)

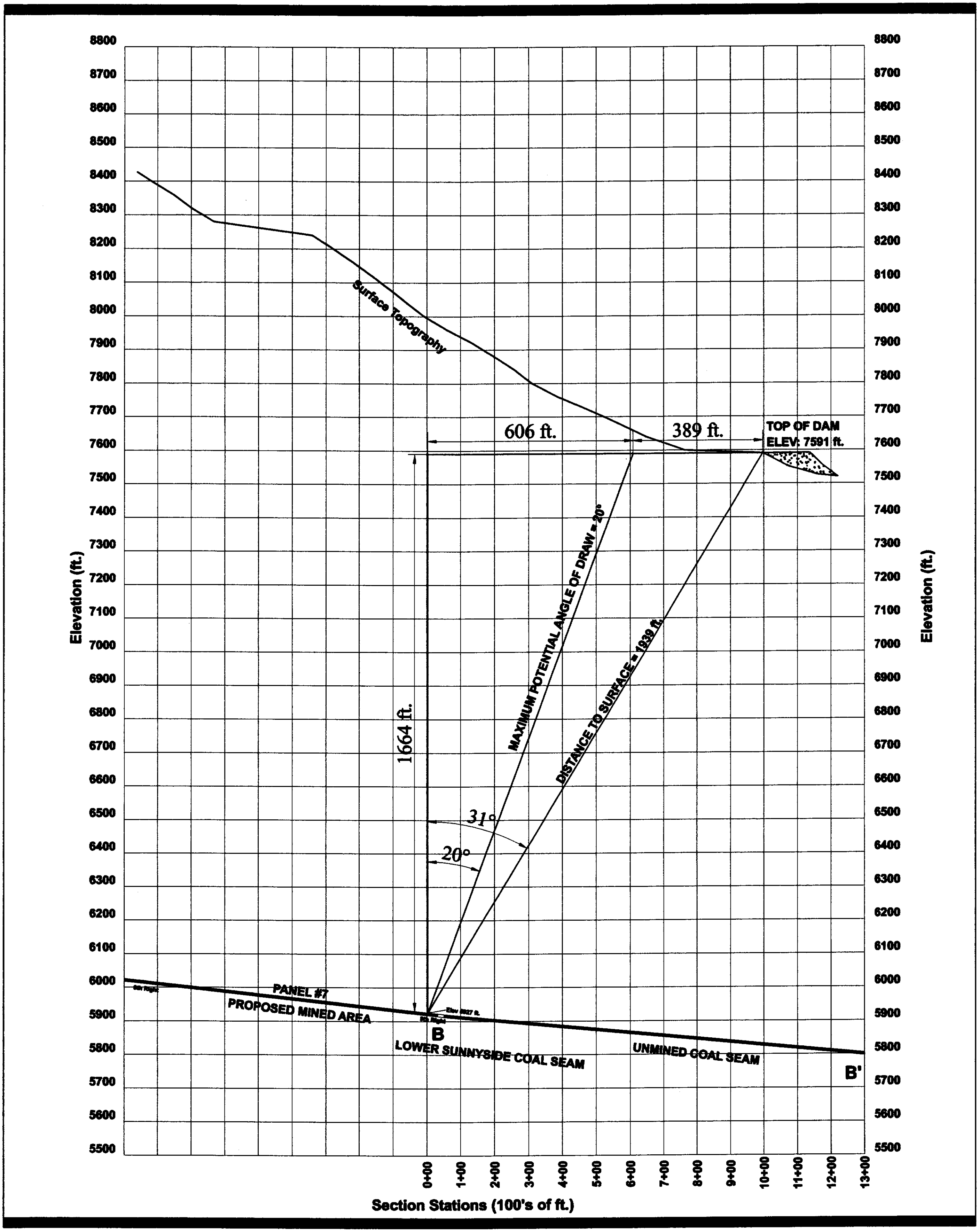

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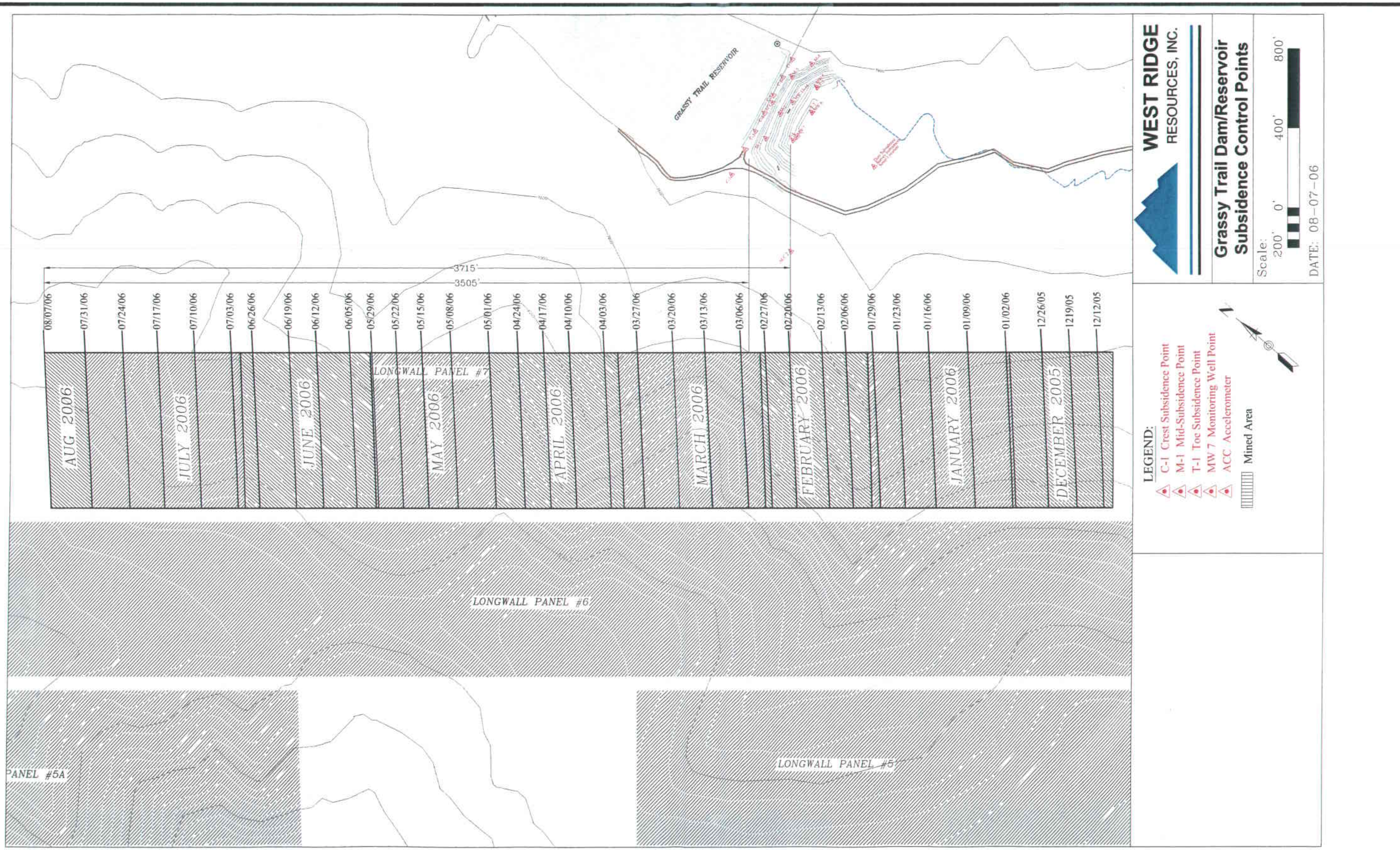
Figure 4
CROSS SECTION THROUGH PANEL 7 AND GRASSY TRAIL DAM



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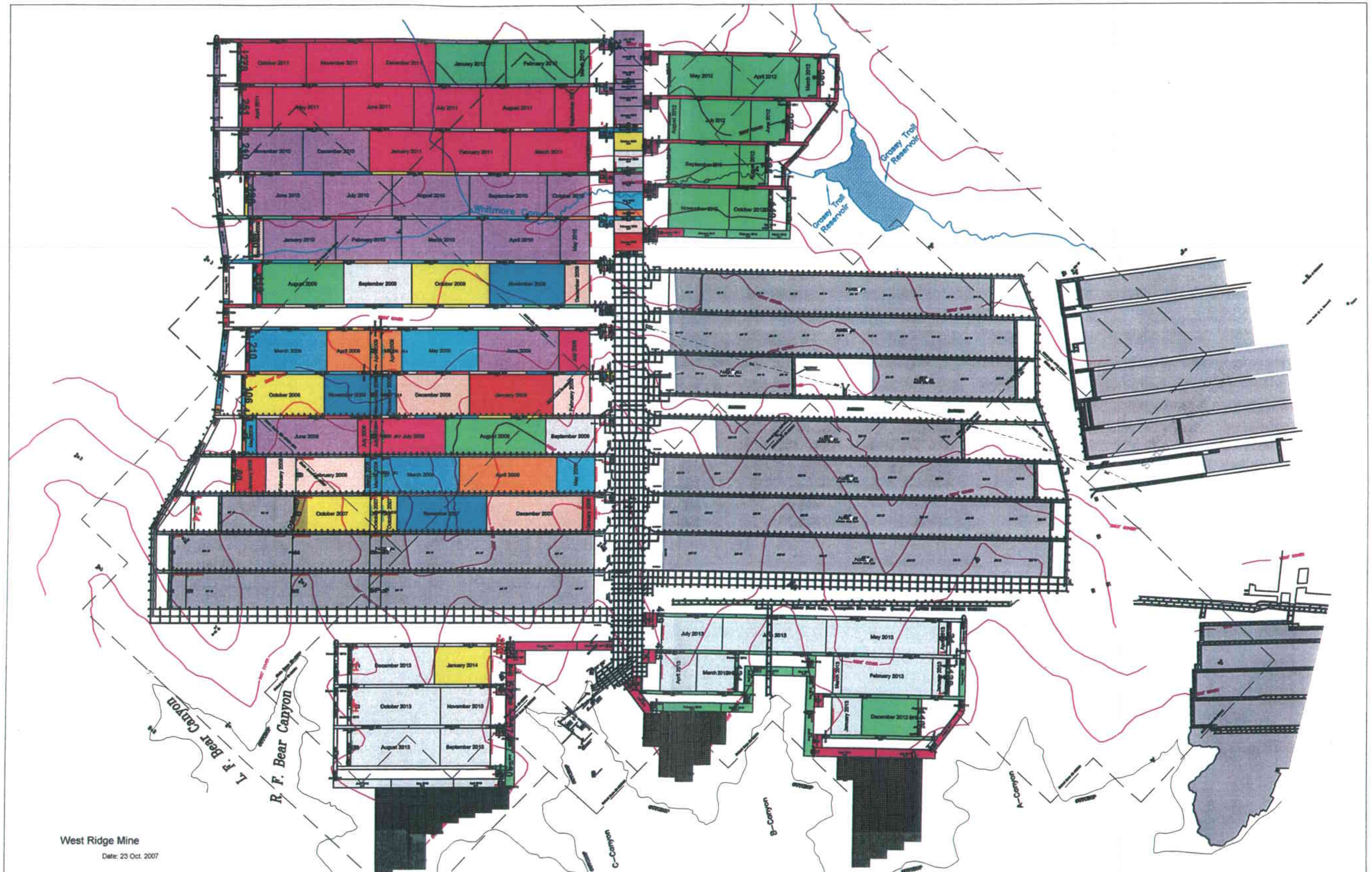
GRASSY TRAIL DAM
CARBON COUNTY, UTAH

Figure 5

ACTUAL DATES OF MINING IN PANEL 7
(THROUGH AUGUST 7, 2006)



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GRASSY TRAIL DAM
CARBON COUNTY, UTAH

PROJECTED FUTURE MINING
(AS OF OCTOBER 2007)

Figure 6

Appendix A

Table A-1
Monthly Summary of Ground Motions

	Device on Dam				Device on Hillside				UUSS Earthquakes	
Month	No. of Events	Max Per Day	Max PPV (mm/s)	Max Accel. (g)	No. of Events	Max Per Day	Max PPV (mm/s)	Max Accel. (g)	No. of Events	Max Magnitude
Jan 2005	0	---	---	---	5	3	1.10	0.015	0	---
Feb 2005	0	---	---	---	30	5	1.49	0.018	4	1.7
Mar 2005	1	1	1.25	0.007	61	6	2.17	0.020	1	1.7
Apr 2005	10	2	1.25	0.012	84	7	1.61	0.020	5	1.8
May 2005	10	2	1.47	0.010	124	14	3.10	0.025	2	2.0
Jun 2005	4	2	2.00	0.010	72	7	3.87	0.032	5	1.6
Jul 2005	0	---	---	---	20	5	1.20	0.018	2	1.6
Aug 2005	28	3	3.26	0.028	56	5	4.75	0.027	30	1.9
Sep 2005	43	4	3.44	0.018	72	5	4.92	0.027	36	1.9
Oct 2005	3	1	1.71	0.017	13	3	1.48	0.018	4	1.6
Nov 2005	0	---	---	---	n/a	removed for re-calibration			8	1.6
Dec 2005	2	1	0.083	0.018	n/a	device moved to new location			2	1.7
Jan 2006	20	3	1.90	0.015	20	3	2.16	0.015	4	1.7
Feb 2006	71	11	5.84	0.058	81	11	9.75	0.091	10	2.2
Mar 2006	183	13	30.4 *	0.268	223	13	33.1 *	0.348	44	2.6
Apr 2006	228	15	20.7	0.182	235	14	17.5	0.159	69	2.1
May 2006	130	12	13.3	0.113	165	12	14.8	0.108	46	2.4
Jun 2006	90	8	8.80	0.075	118	9	7.30	0.099	61	2.0
Jul 2006	93	8	5.59	0.048	98	7	4.40	0.035	77	2.1
Aug 2006	72	6	2.15	0.020	64	6	2.15	0.018	110	1.9
Sep 2006	16	2	2.05	0.018	17	3	1.19	0.083	44	1.9
Oct 2006	0	---	---	---	0	---	---	---	0	---
Nov 2006	0	---	---	---	1	1	0.752	0.010	0	---
Dec 2006	0	---	---	---	0	---	---	---	1	1.3
Jan 2007	0	---	---	---	0	---	---	---	2	1.6
Feb 2007	0	---	---	---	0	---	---	---	1	1.5
Mar 2007	0	---	---	---	0	---	---	---	40	2.0
Apr 2007	0	---	---	---	0	---	---	---	17	1.6
May 2007	0	---	---	---	1	1	2.50	0.020	41	1.9
Jun 2007	n/a	errors			1	1	1.05	0.010	61	2.0
Jul 2007	n/a	removed for re-calibration			1	1	0.902	0.008	47	2.3
Aug 2007	n/a	---	---	---	1	1	0.074	0.010	23	1.6
Sep 2007	n/a	---	---	---	0	---	---	---	1	1.7
Oct 2007	n/a	---	---	---	0	---	---	---	24	1.8
Nov 2007	0	---	---	---	n/a	removed for re-calibration			45	2.1
Dec 2007	0	---	---	---	n/a	---	---	---	59	2.1
Jan 2008	7	1	2.98	0.027	n/a	removed for repair			35	2.4

Notes: Max. PPV = Maximum Peak Vector Sum Particle Velocity Recorded During the Month
Max. Accel. = Maximum Peak Acceleration Recorded During the Month
* PPV value greater than range limit (31.7mm/s). Value shown may be lower than actual PPV

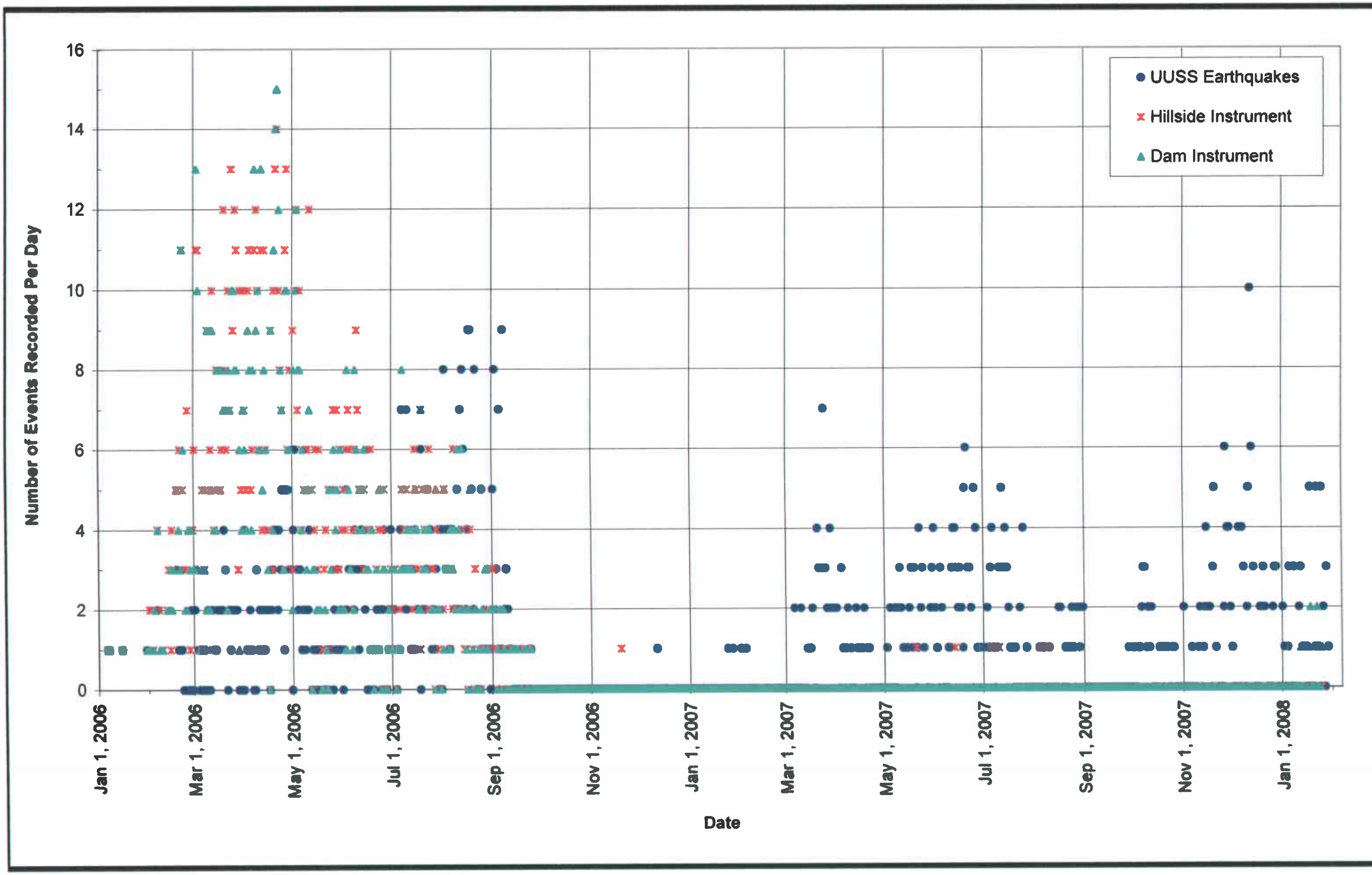

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FIGURE A-1

NUMBER OF EVENTS RECORDED PER DAY (SINCE JAN 1, 2006)
GRASSY TRAIL DAM - CARBON COUNTY, UTAH

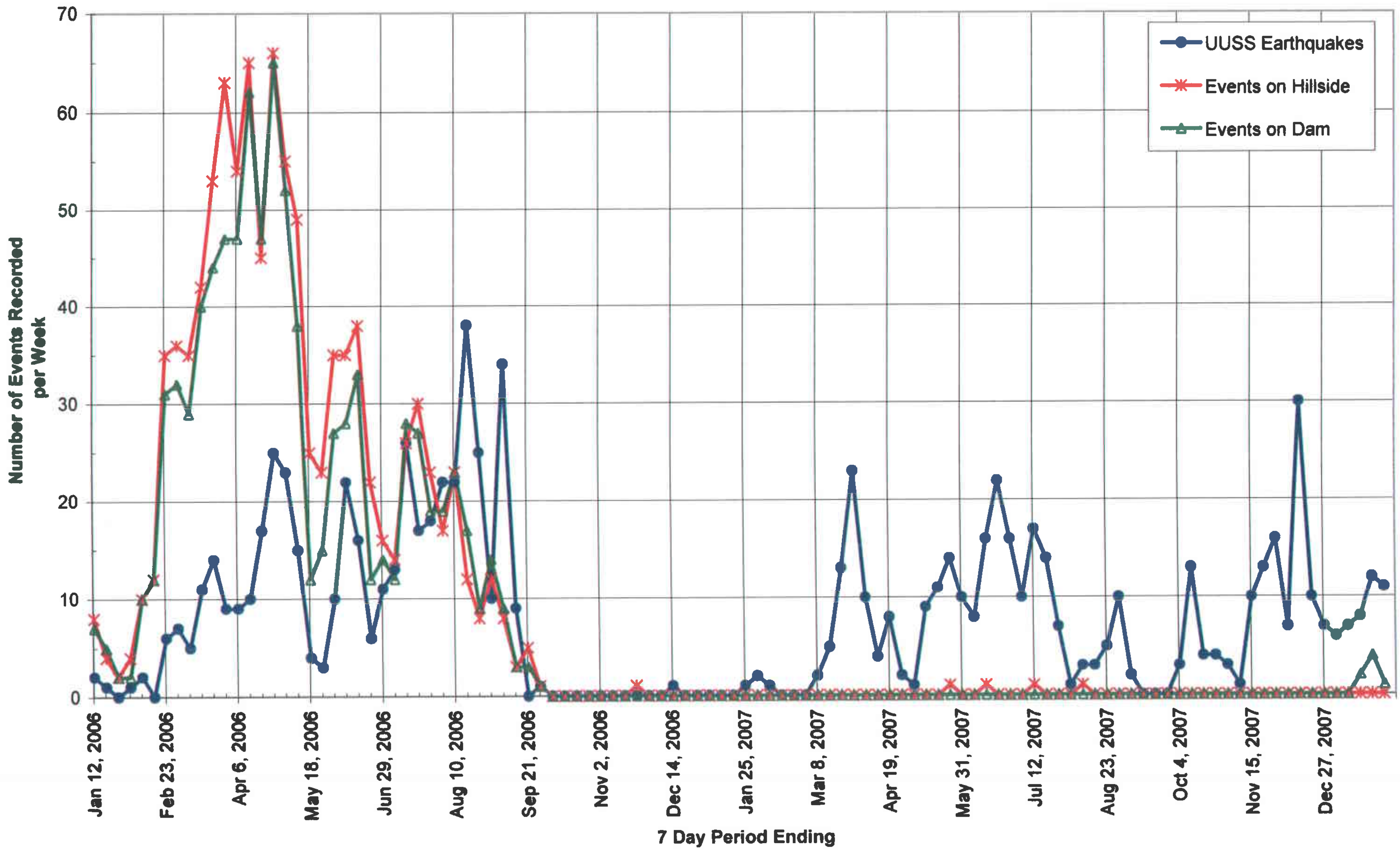

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FIGURE A-2

NUMBER OF EVENTS RECORDED PER WEEK
GRASSY TRAIL DAM - CARBON COUNTY, UTAH

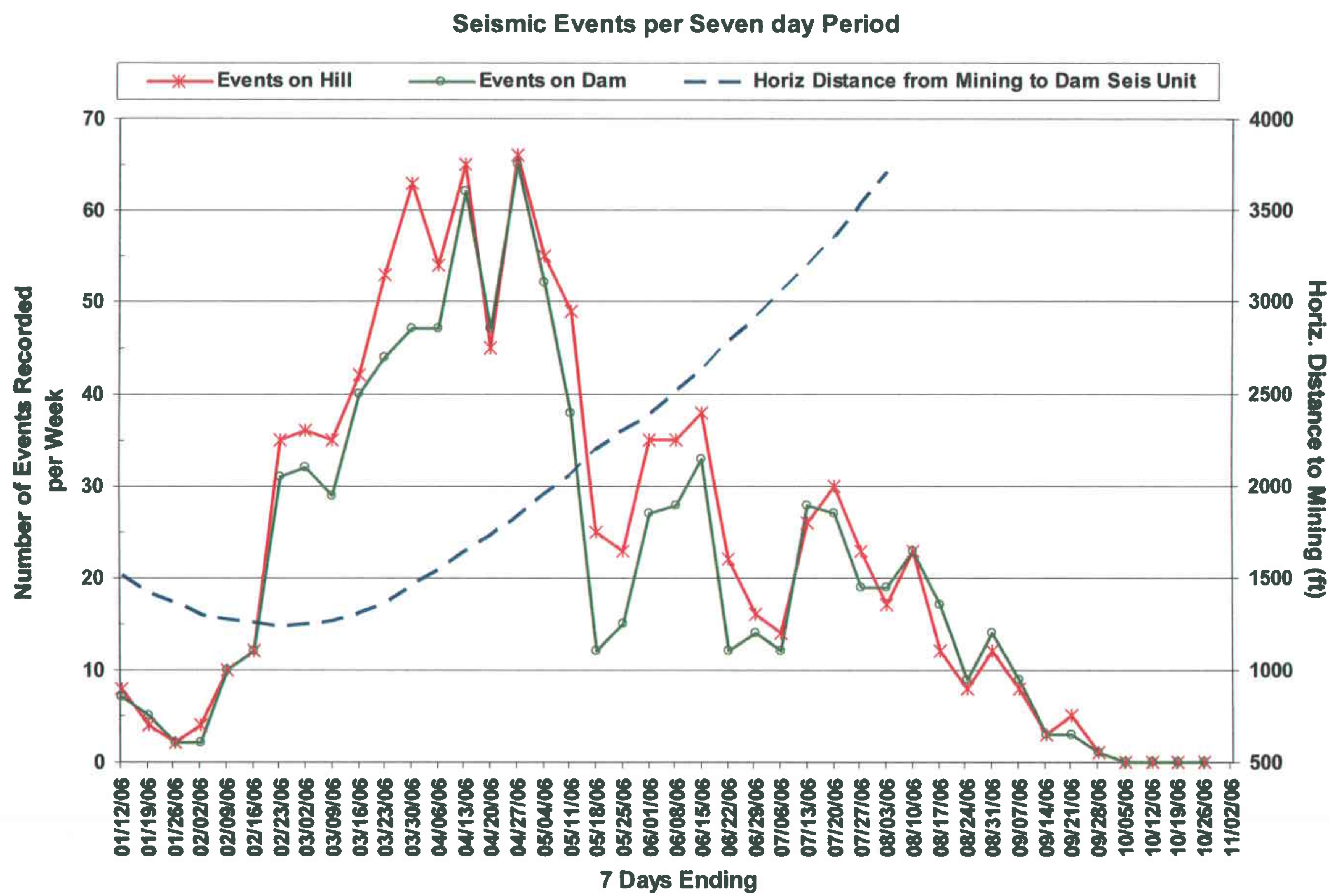

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FIGURE A-3

EVENTS PER WEEK AND PROXIMITY TO MINING DURING 2006

GRASSY TRAIL DAM - CARBON COUNTY, UTAH

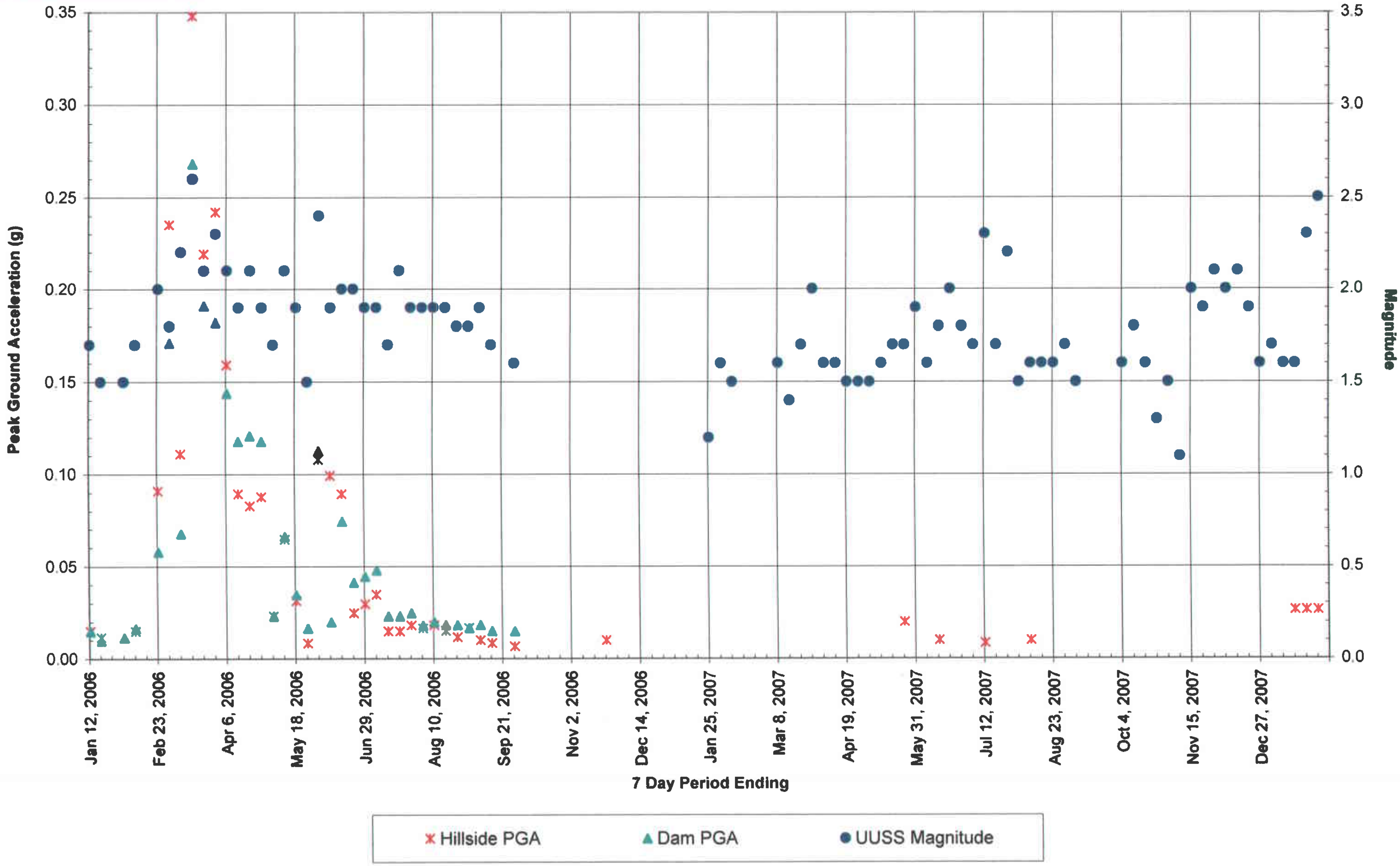

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FIGURE A-4

PEAK GROUND ACCELERATIONS AND EVENT MAGNITUDES VERSUS TIME

GRASSY TRAIL DAM - CARBON COUNTY, UTAH

Appendix B

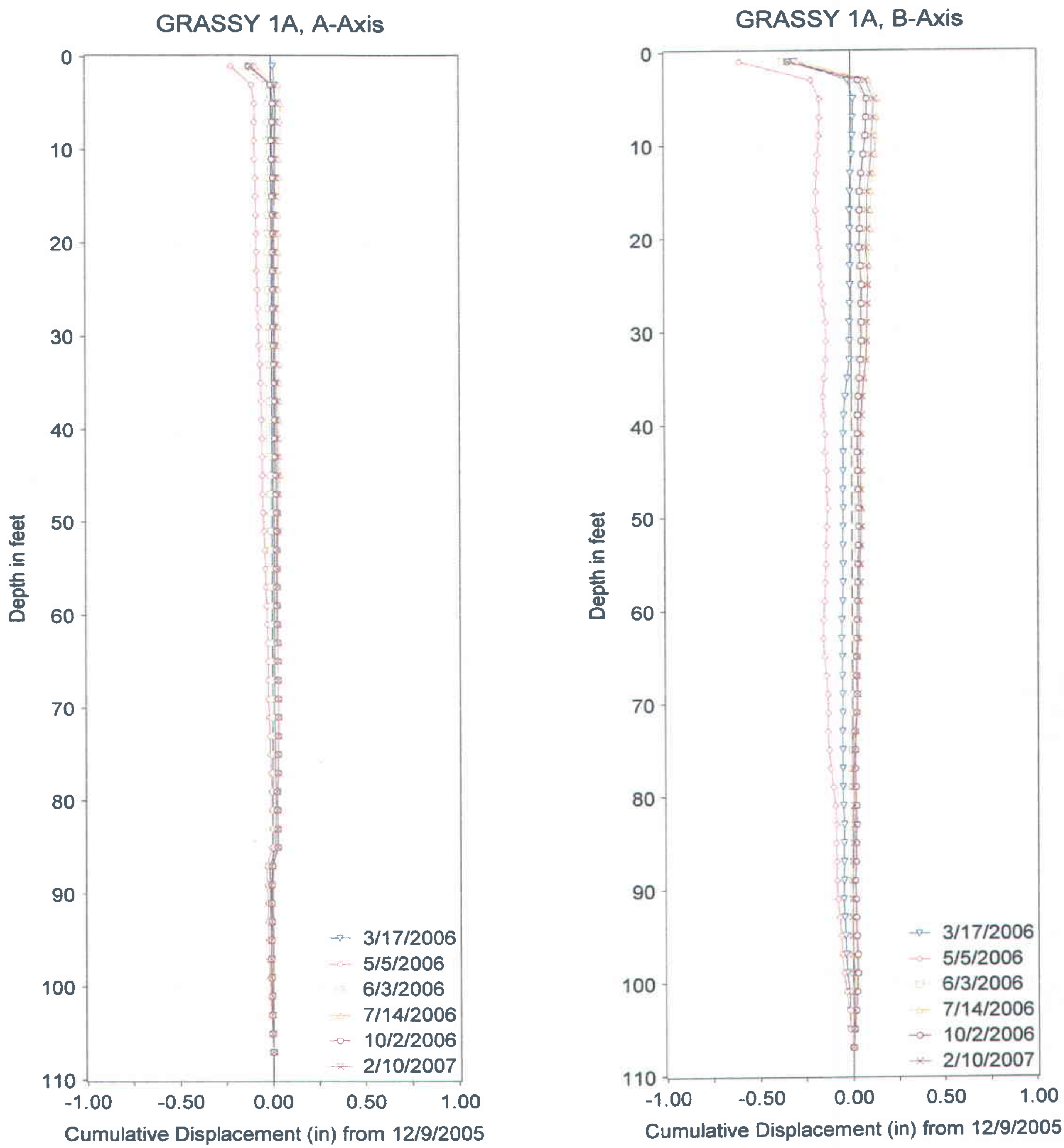

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FIGURE B-1

INCLINOMETER 1 - DEFLECTION PROFILES
GRASSY TRAIL DAM AND RESERVOIR - CARBON COUNTY, UTAH

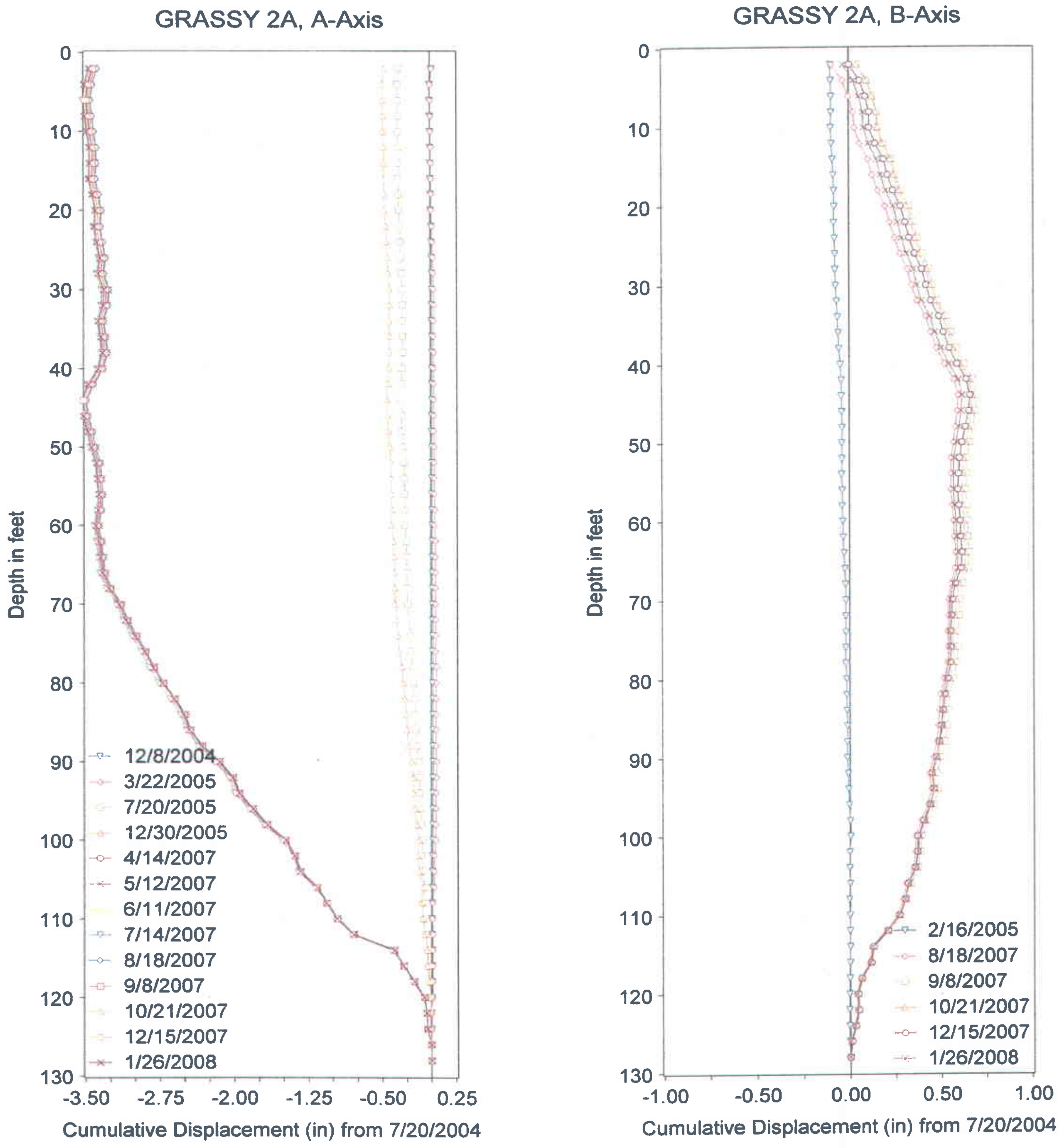

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FIGURE B-2

INCLINOMETER 2 - DEFLECTION PROFILES
GRASSY TRAIL DAM AND RESERVOIR - CARBON COUNTY, UTAH

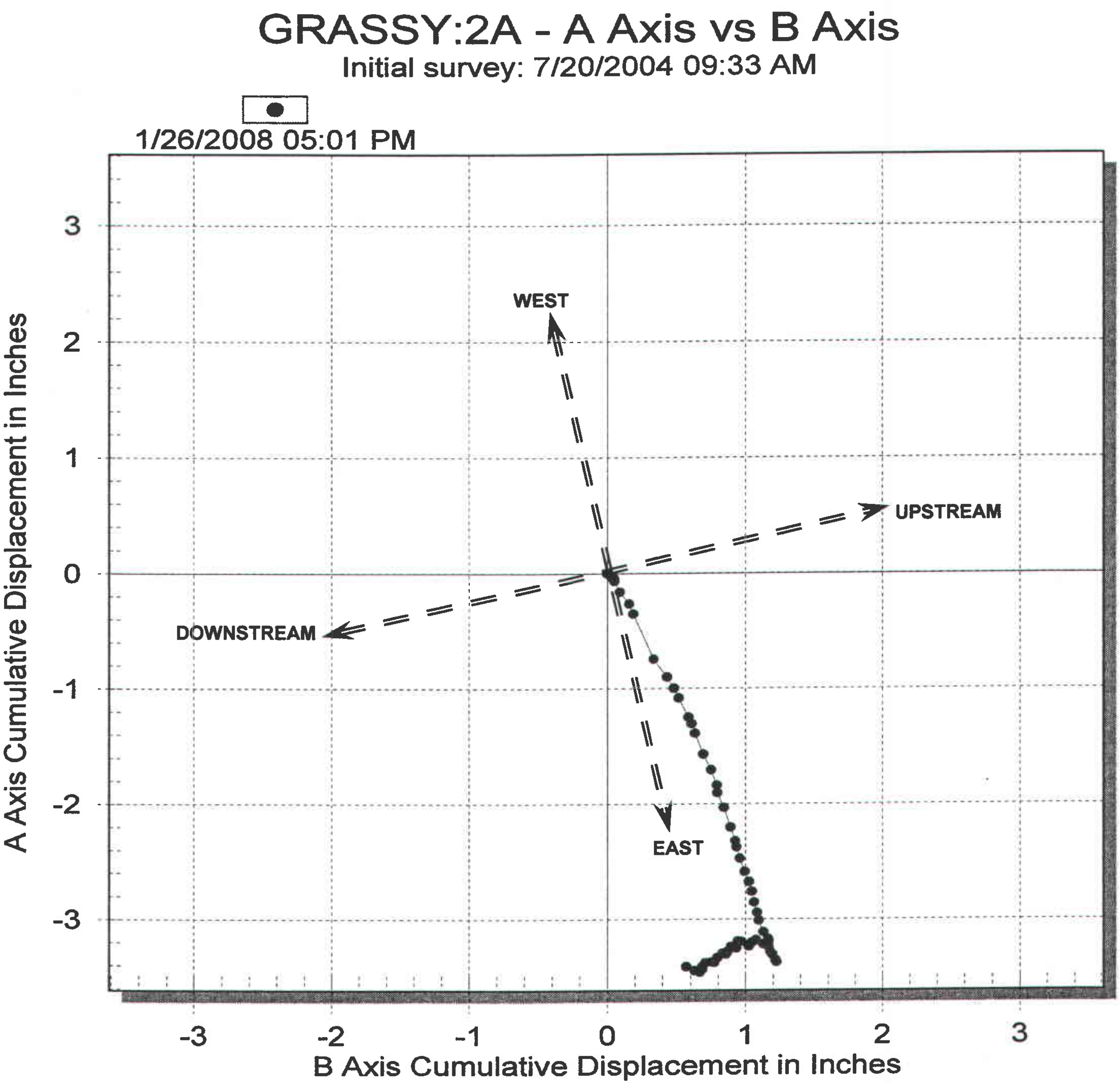

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FIGURE B-3

INCLINOMETER 2 - PLAN VIEW OF DEFLECTIONS
GRASSY TRAIL DAM AND RESERVOIR - CARBON COUNTY, UTAH

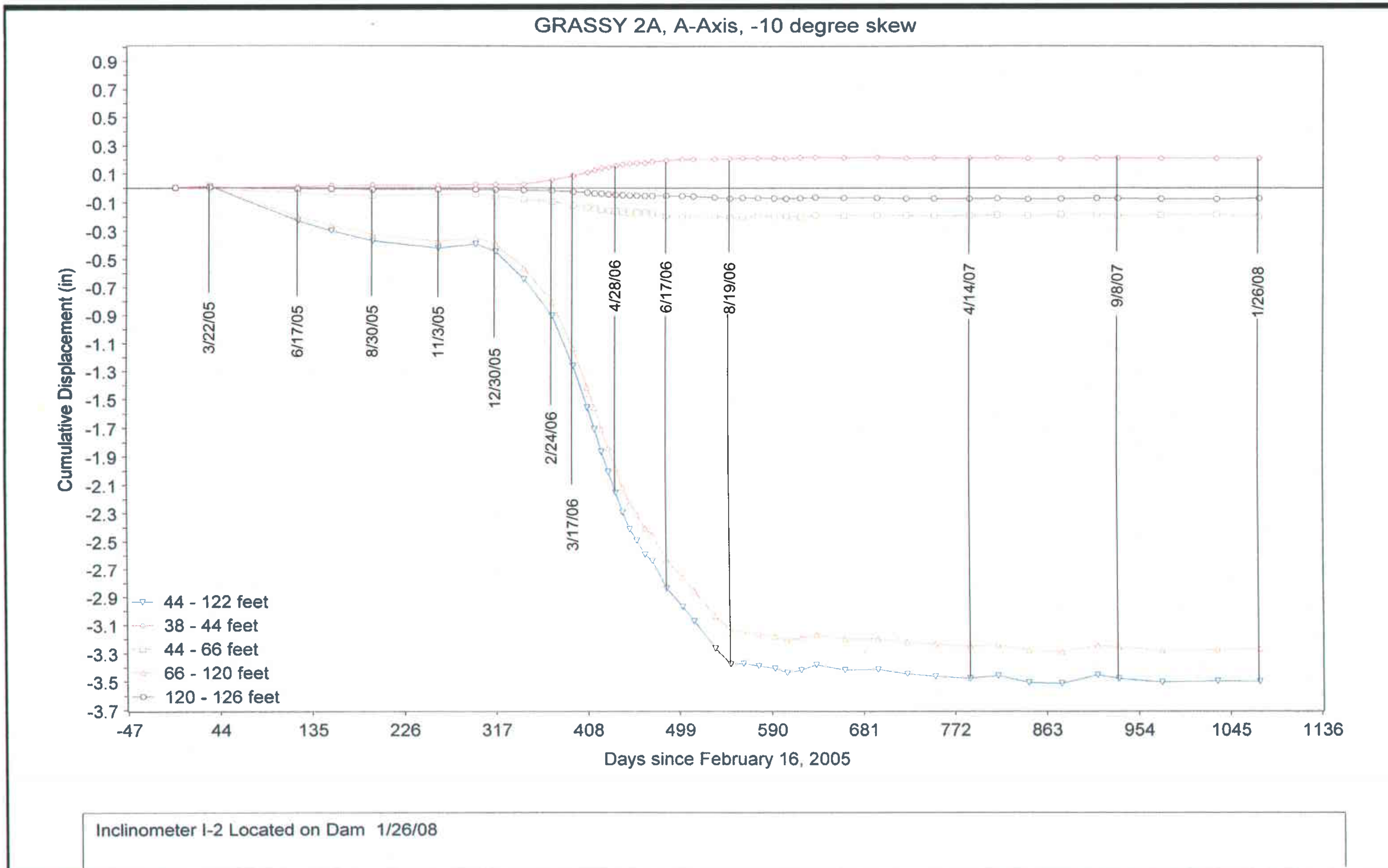

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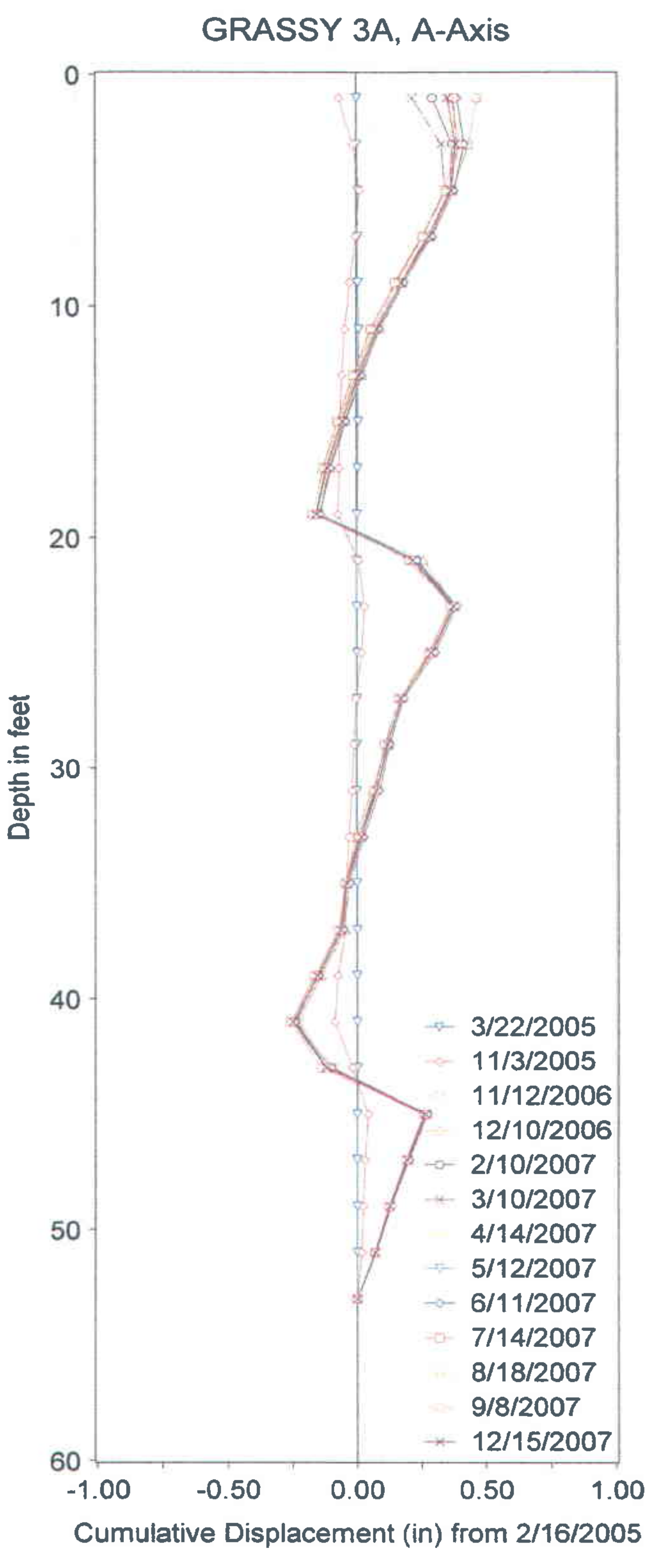
FIGURE B-4

INCLINOMETER 2 - DEFLECTIONS VERSUS TIME
GRASSY TRAIL DAM - CARBON COUNTY, UTAH



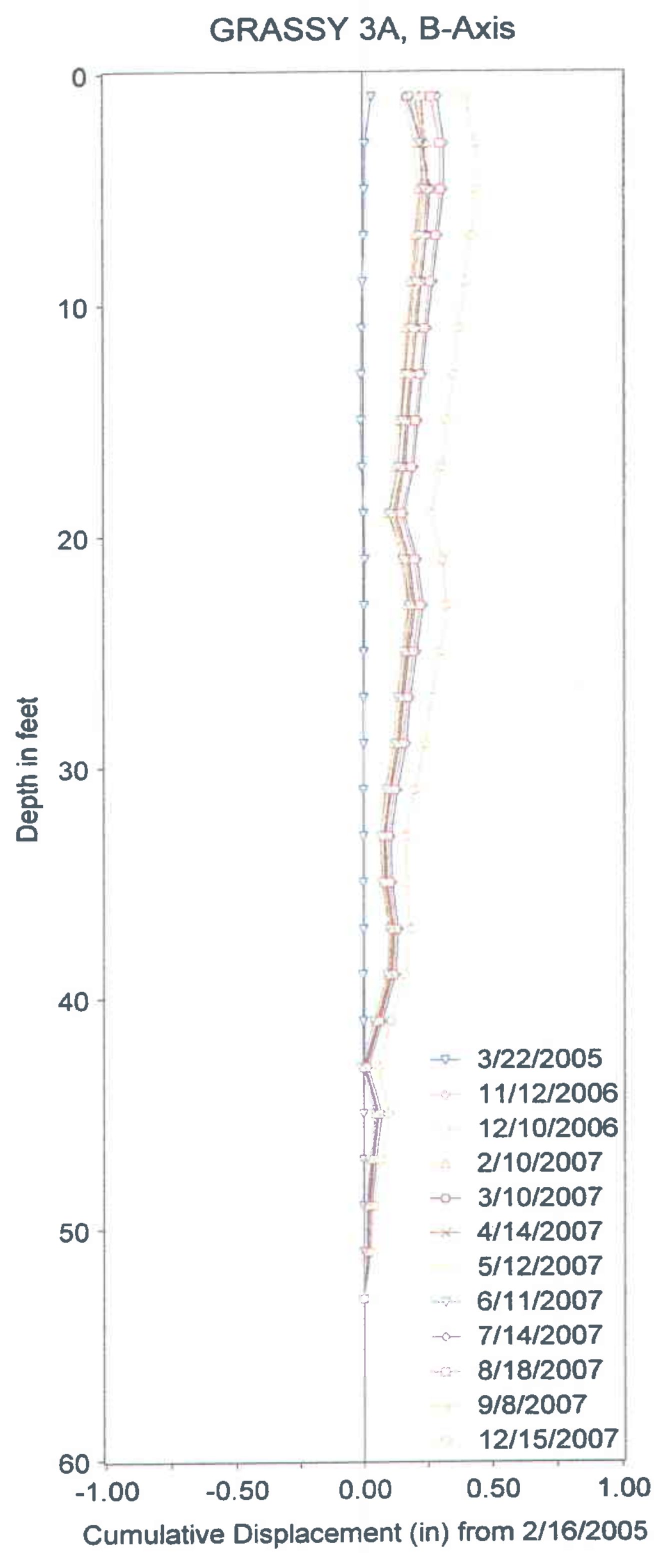


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FIGURE B-5

INCLINOMETER 3 - DEFLECTION PROFILES

GRASSY TRAIL DAM AND RESERVOIR - CARBON COUNTY, UTAH

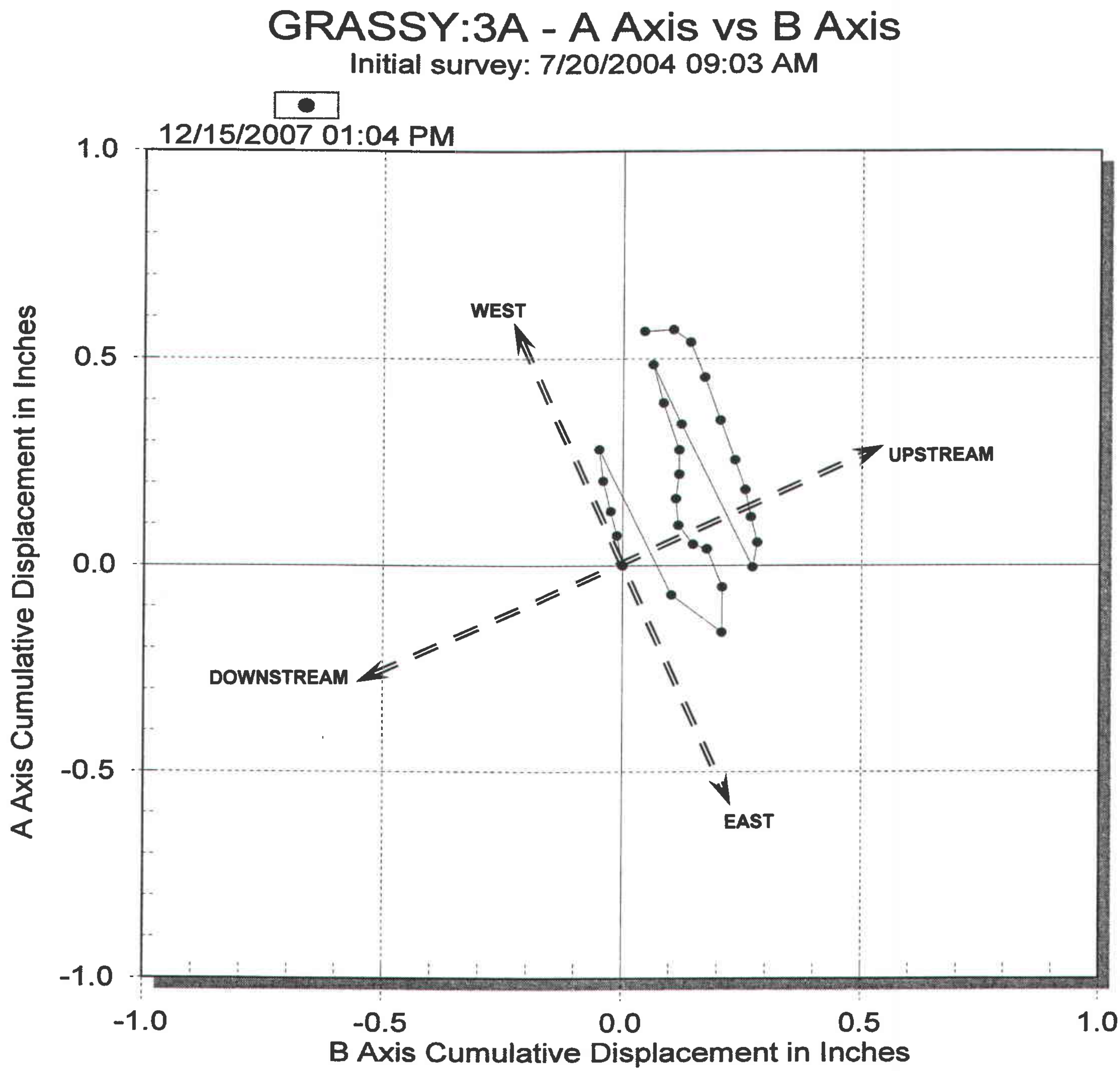

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FIGURE B-6

INCLINOMETER 3 - PLAN VIEW OF DEFLECTIONS

GRASSY TRAIL DAM AND RESERVOIR - CARBON COUNTY, UTAH

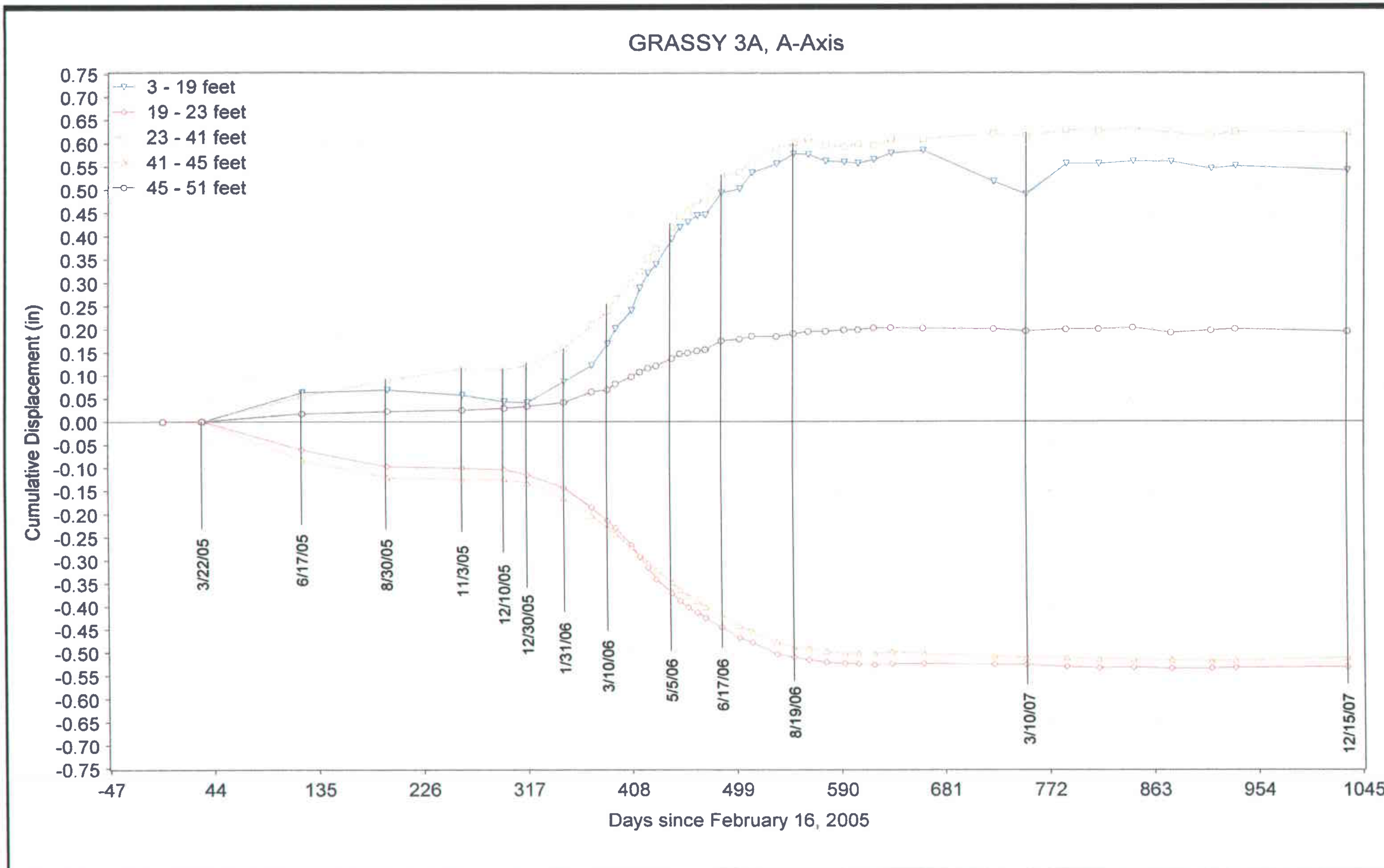

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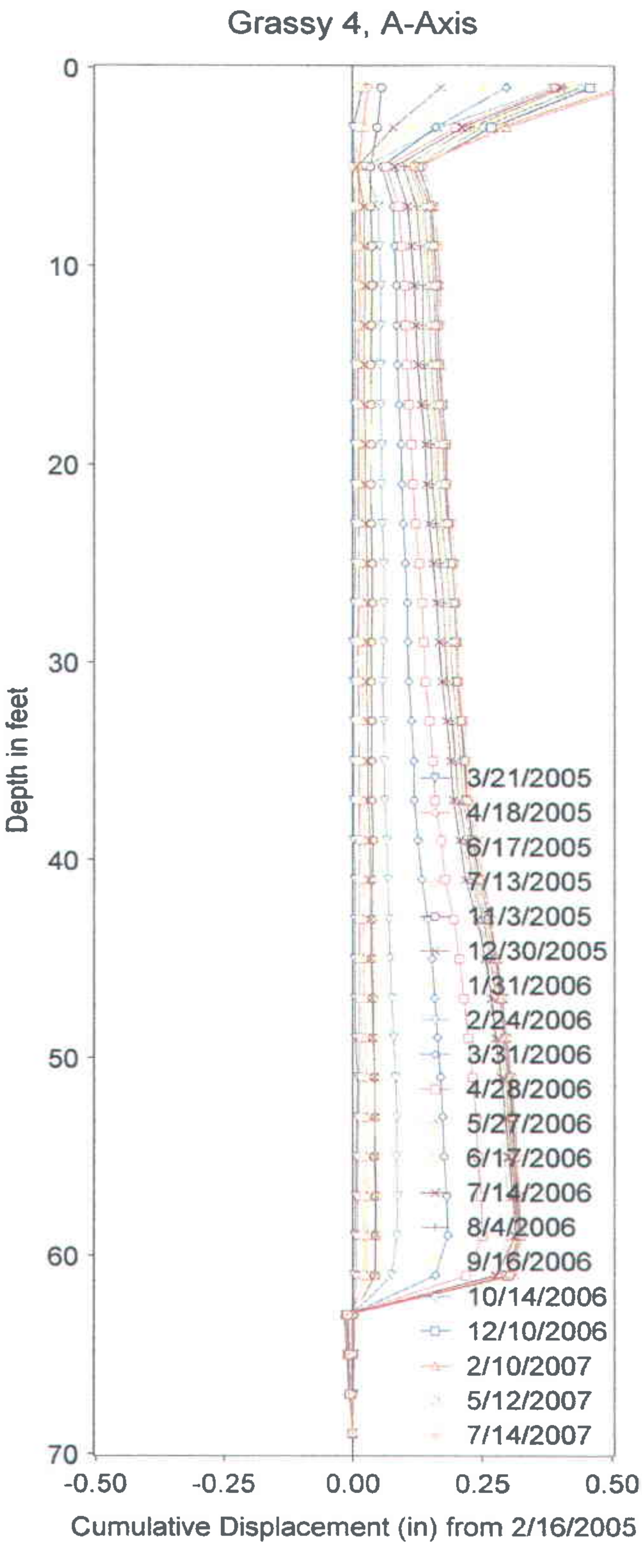
FIGURE B-7

INCLINOMETER 3 - DEFLECTIONS VERSUS TIME
GRASSY TRAIL DAM - CARBON COUNTY, UTAH



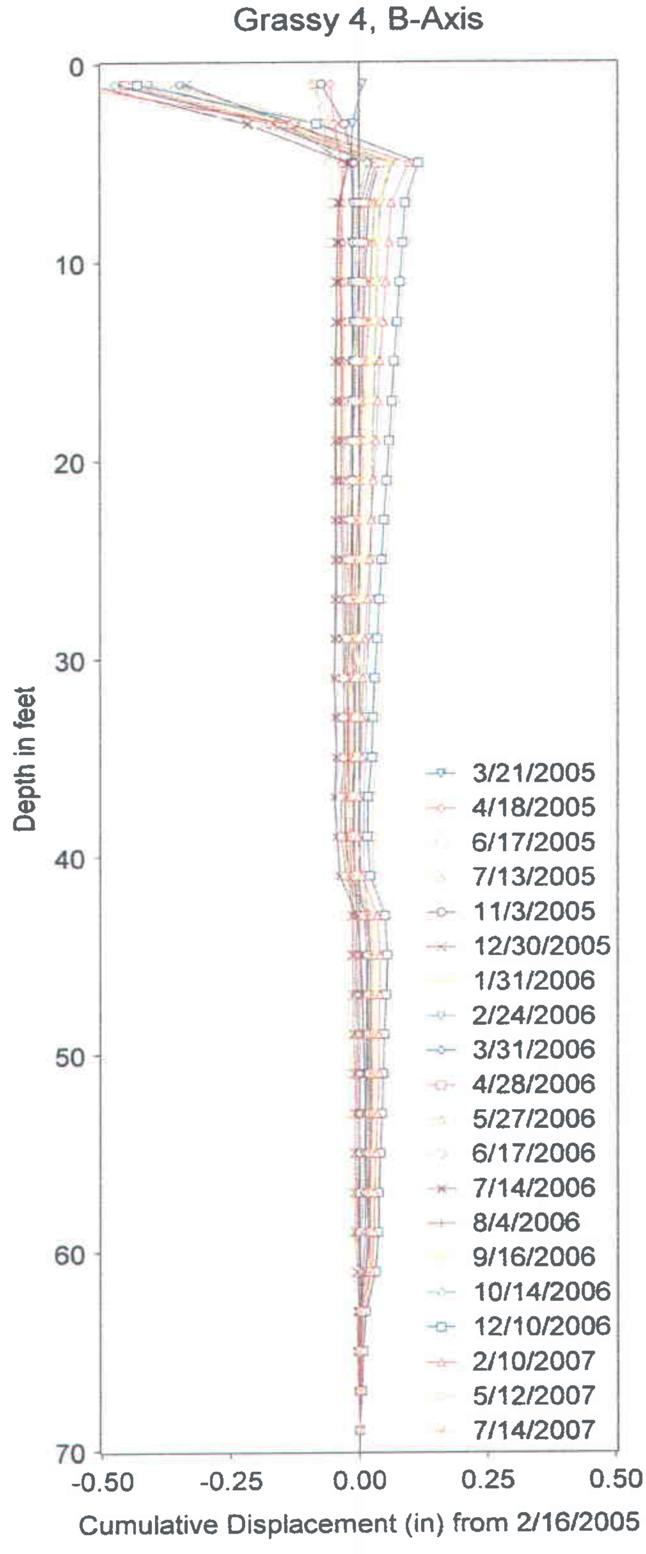


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FIGURE B-8

INCLINOMETER 4 - DEFLECTION PROFILES
GRASSY TRAIL DAM AND RESERVOIR - CARBON COUNTY, UTAH

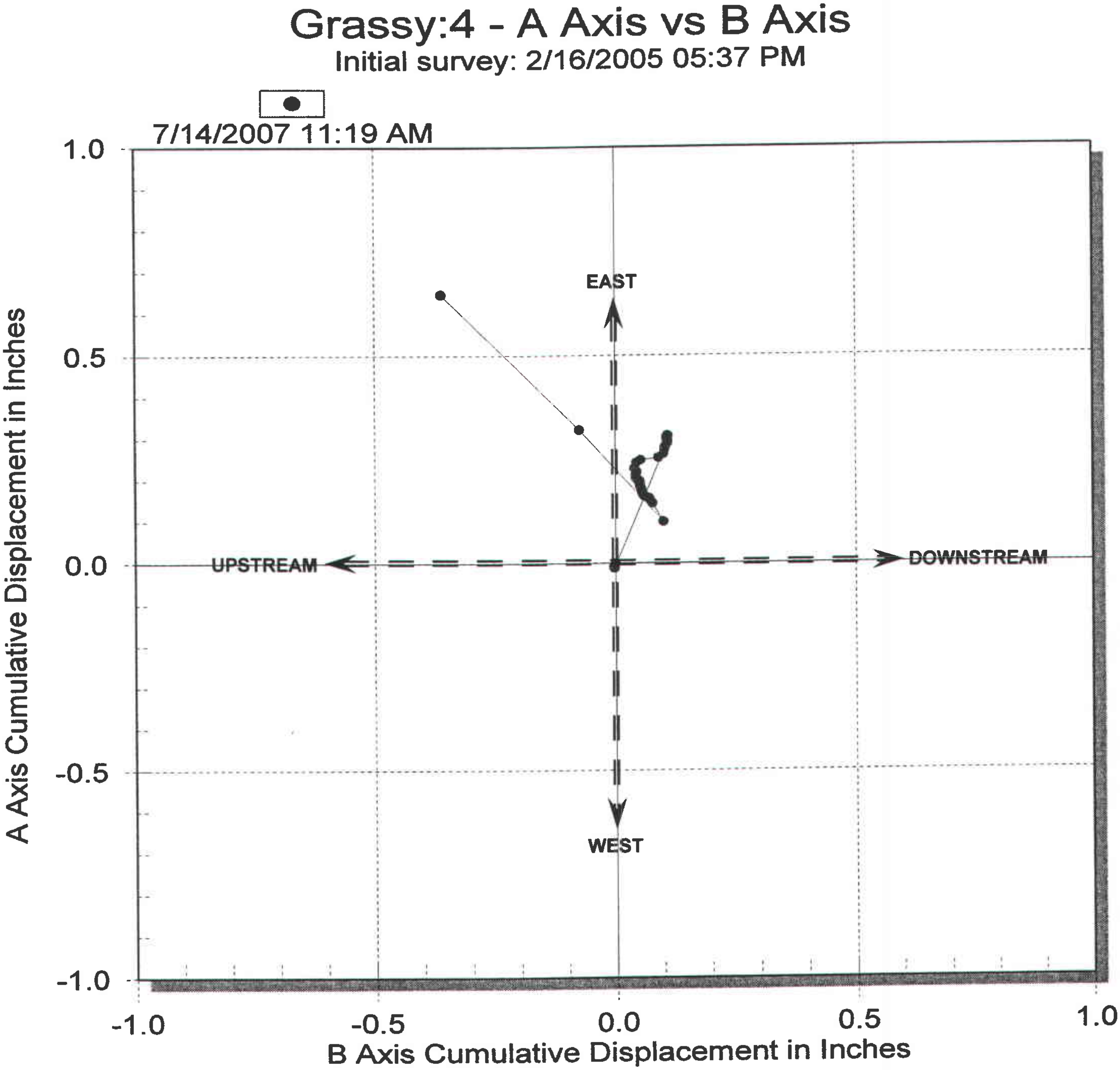

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FIGURE B-9

INCLINOMETER 4 - PLAN VIEW OF DEFLECTIONS

GRASSY TRAIL DAM AND RESERVOIR - CARBON COUNTY, UTAH

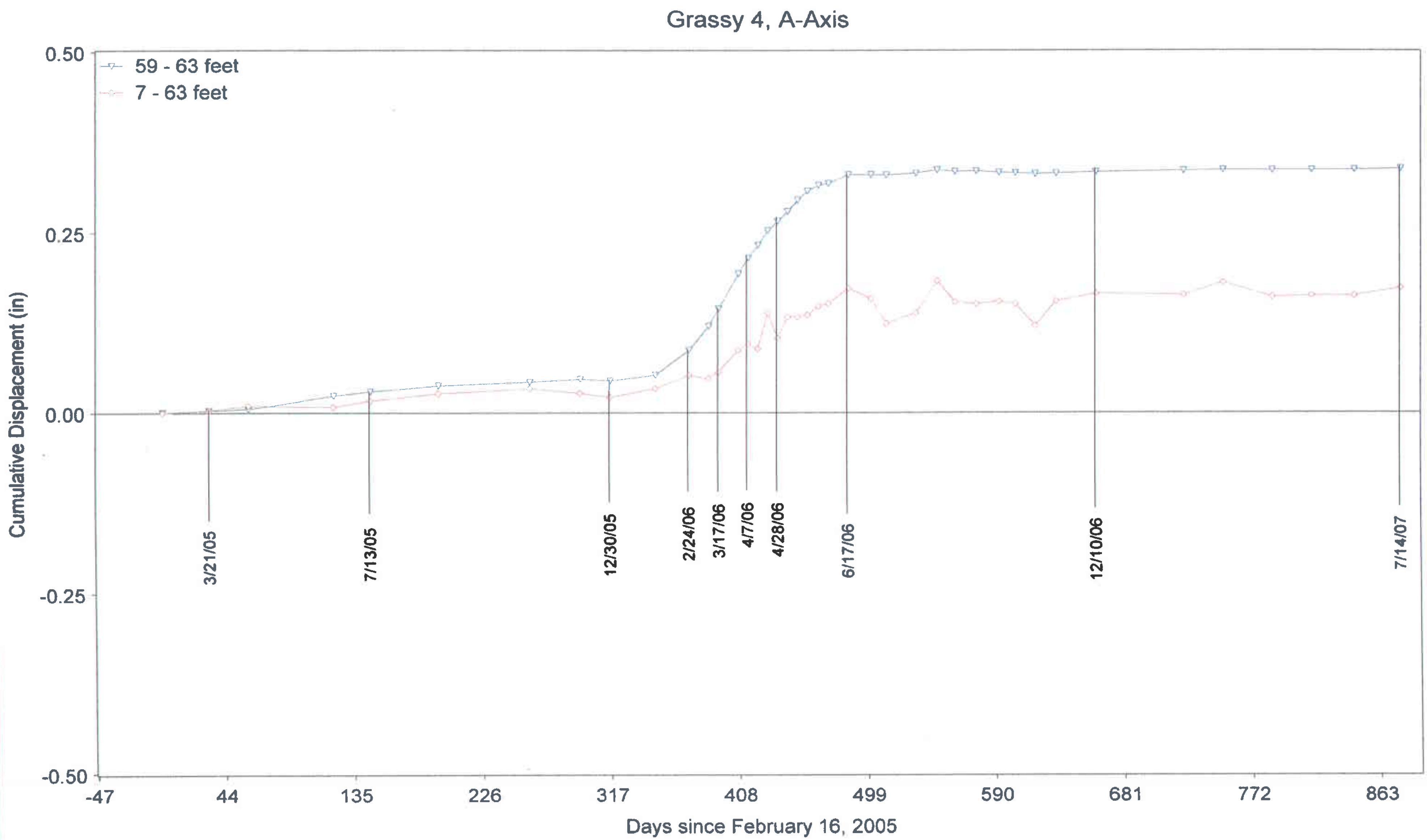

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FIGURE B-10

INCLINOMETER 4 - DEFLECTIONS VERSUS TIME
GRASSY TRAIL DAM - CARBON COUNTY, UTAH

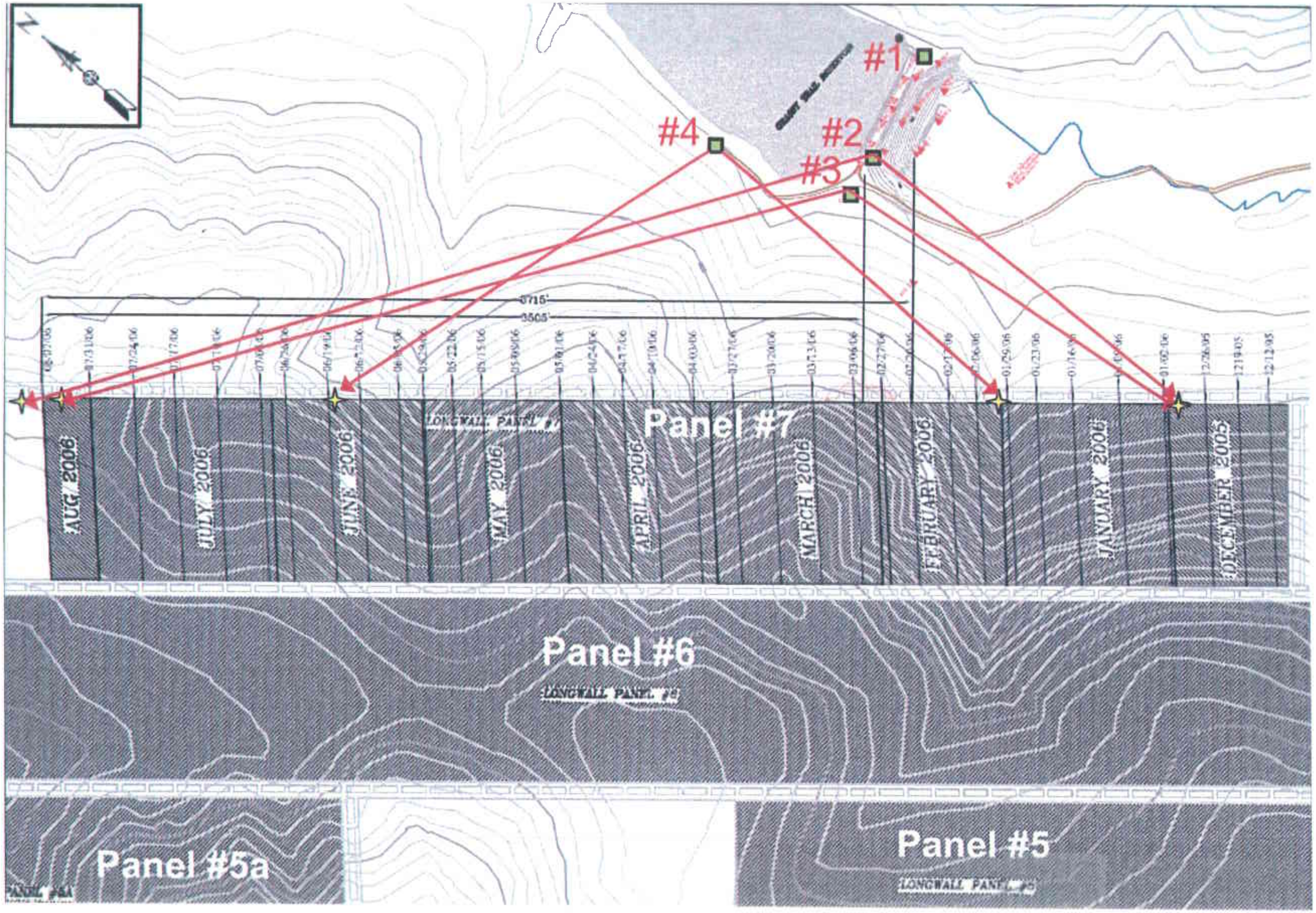

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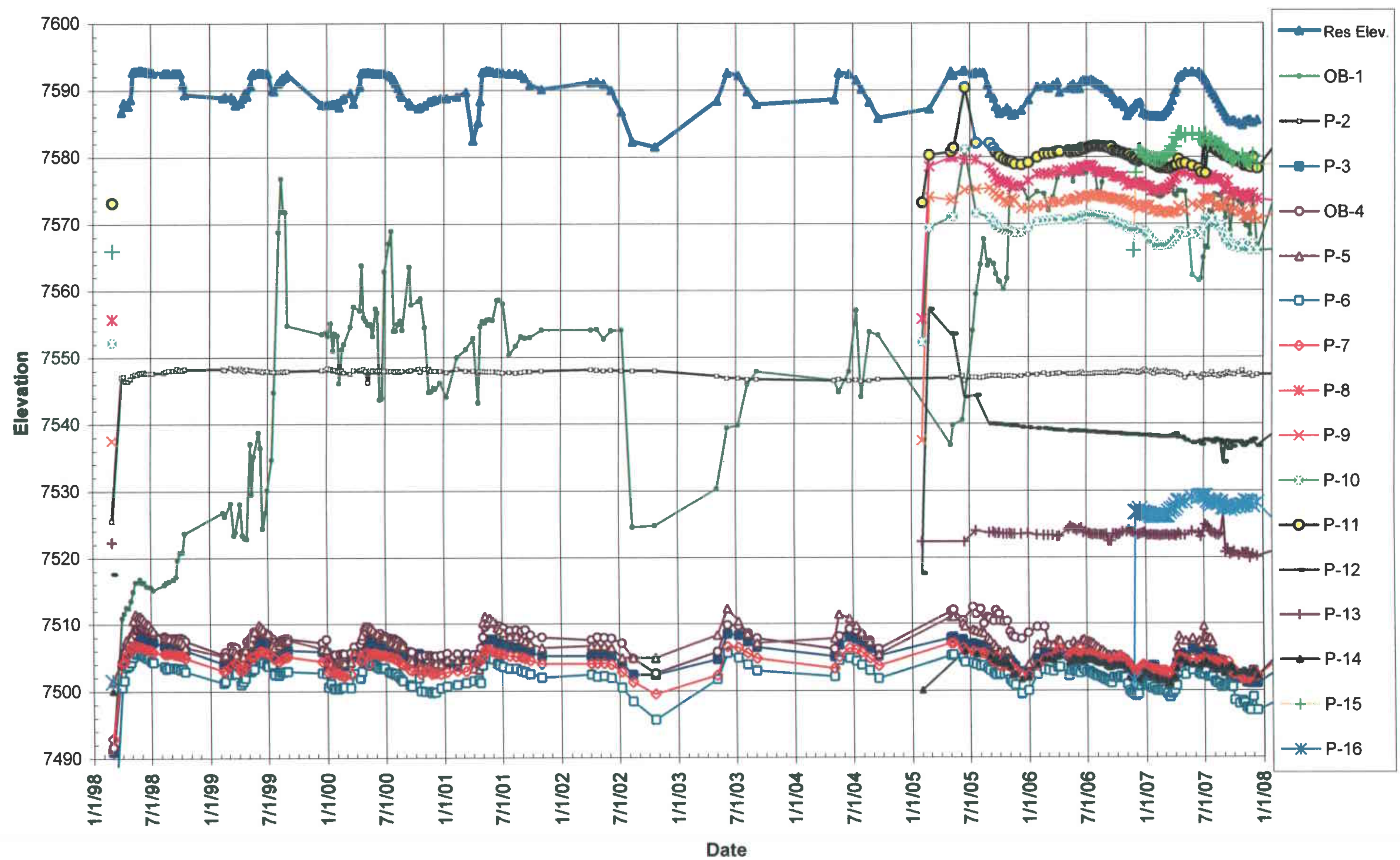
FIGURE B-11

APPROXIMATE ZONES OF SIGNIFICANT MINING-INDUCED DEFLECTION
GRASSY TRAIL DAM - CARBON COUNTY, UTAH

Appendix C



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Provo, Utah

FIGURE C-1

WATER LEVELS VERSUS TIME

GRASSY TRAIL DAM - CARBON COUNTY, UTAH

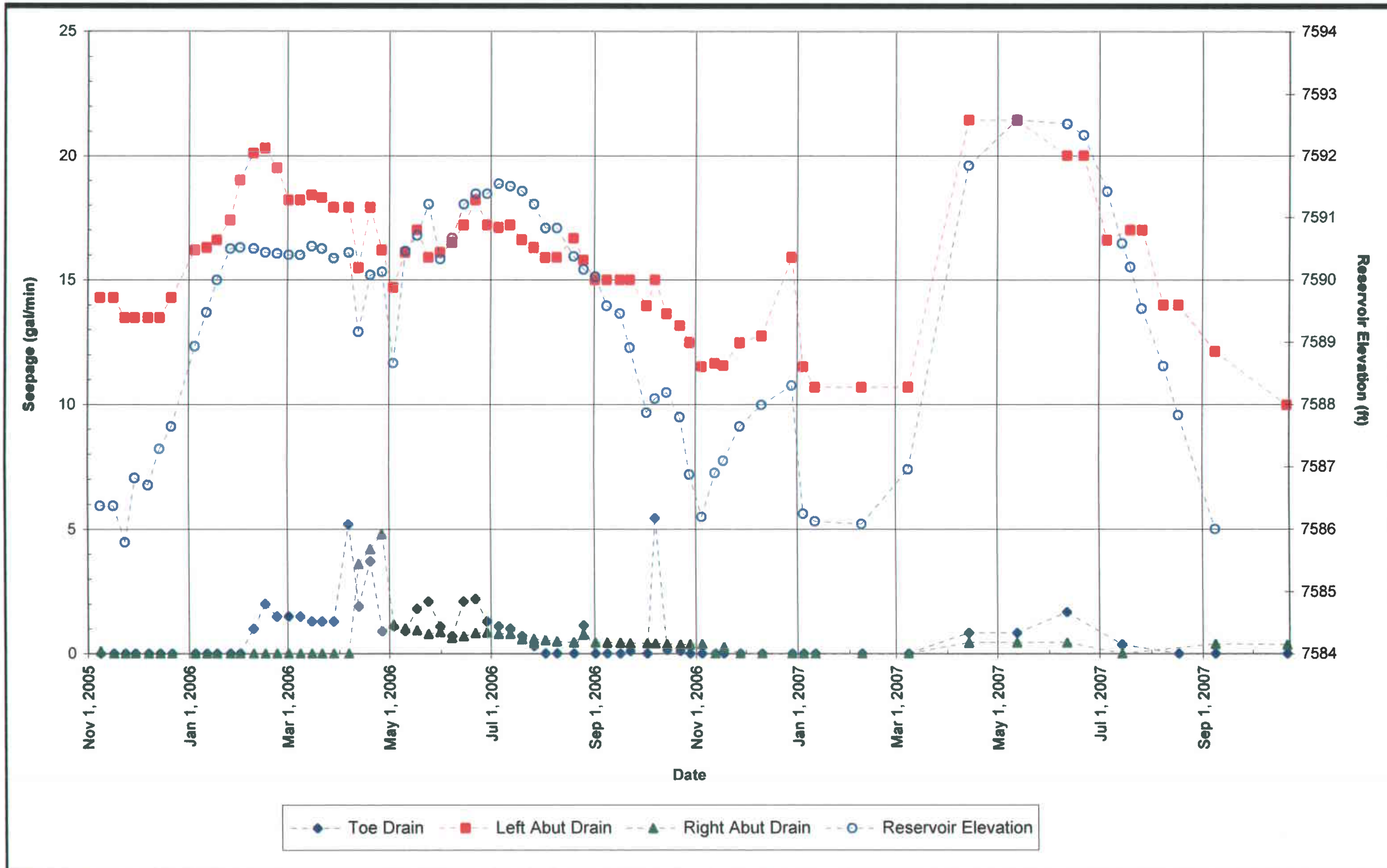

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FIGURE C-2

SEEPAGE MEASUREMENTS VERSUS TIME

GRASSY TRAIL DAM - CARBON COUNTY, UTAH

Appendix D

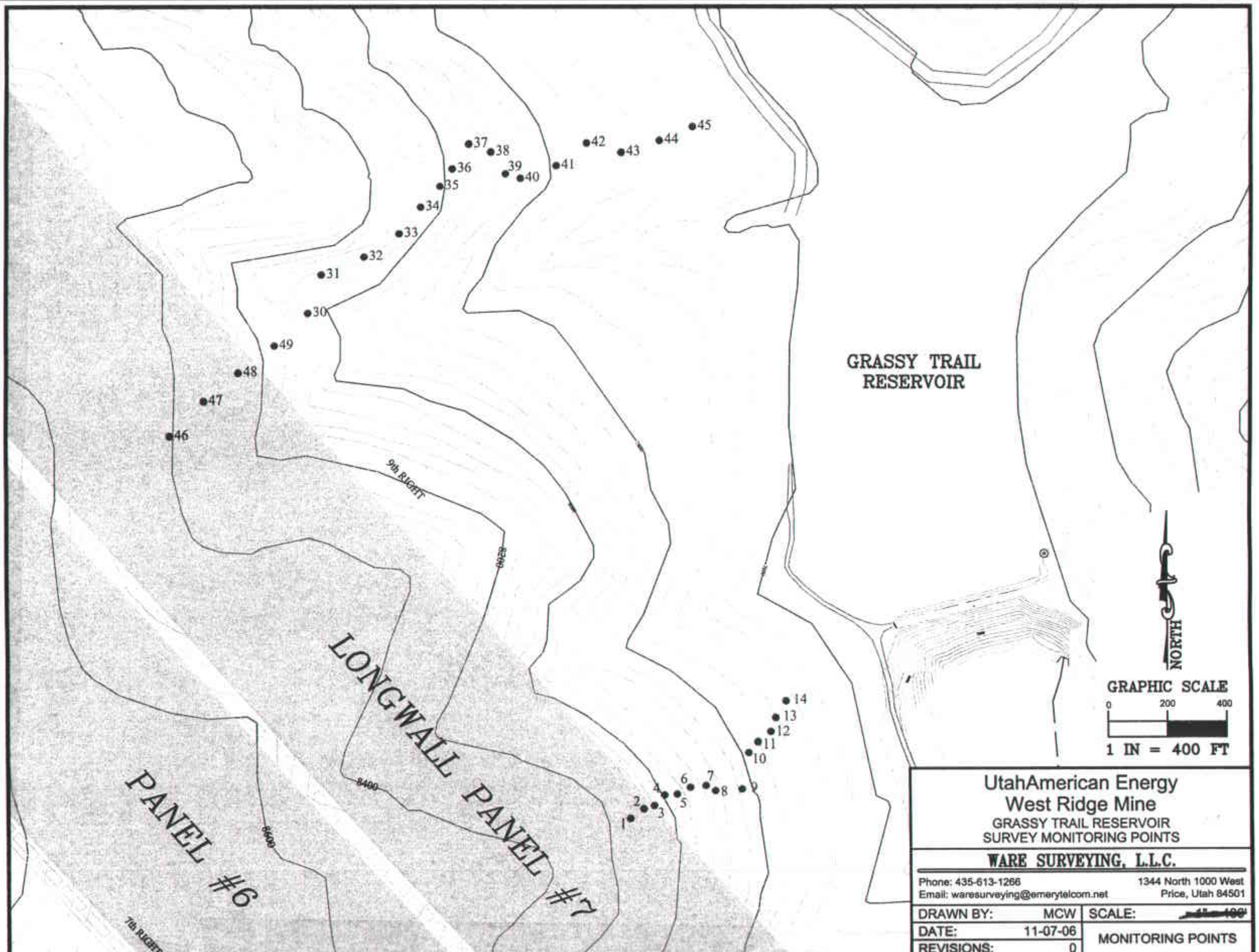

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FIGURE D-1

HILLSIDE SURVEY POINT LOCATIONS

GRASSY TRAIL DAM - CARBON COUNTY, UTAH

TABLE D-1 SURVEYED COORDINATES OF HILLSIDE SURVEY POINTS

WEST RIDGE RESOURCES, INC.
GRASSY TRAIL RESERVOIR SUBSIDENCE SURVEY

STATION	NORTHING	EASTING	ELEVATION	NORTHING	EASTING	ELEVATION	NORTHING	EASTING	ELEVATION	NORTHING	EASTING	ELEVATION	NORTHING	EASTING	ELEVATION	NORTHING	EASTING	ELEVATION	DESCRIPTION
CALIBRATION CONTROL																			
1	38880.51	37416.3	7591.25																drill hole in stone
24	37041.51	39338.42	7453.47																aerial
2	40772.17	37689.12	7645.98																aerial
MEASURED	SEPT 2004			NOV 2004			AUG 2005			APRIL 2006			OCTOBER 2006			MAY 2007			
1	38219.95	36571.37	8172.50	38220.06	36571.39	8172.74	38218.83	36572.19	8172.48	38219.85	36572.39	8171.43	38219.98	36572.48	8170.75	38219.94	36572.55	8170.66	1/2" rebar w/cap
2	38252.72	36617.52	8129.70	38252.61	36617.46	8129.79	38252.84	36617.76	8129.43	38252.36	36618.19	8128.76	38252.57	36618.18	8128.12	38252.50	36618.24	8128.04	1/2" rebar w/cap
3	38263.93	36653.34	8094.67	38263.95	36653.36	8094.74	38264.06	36653.59	8094.52	38263.71	36654.04	8093.74	38263.90	36654.21	8093.38	38263.88	36654.28	8093.37	1/2" rebar w/cap
4	38299.57	36688.08	8059.73	38299.59	36687.98	8059.67	38299.65	36688.16	8059.50	38299.47	36688.71	8058.82	38299.55	36688.92	8058.41	38299.58	36688.94	8058.54	1/2" rebar w/cap
5	38301.95	36730.52	8023.64	38301.94	36730.42	8023.62	38302.04	36730.77	8023.47	38301.86	36731.28	8022.88	38302.05	36731.49	8022.58	38302.08	36731.51	8022.64	1/2" rebar w/cap
6	38325.65	36774.39	7987.63	38325.68	36774.33	7987.66	38325.78	36774.54	7987.57	38325.54	36775.01	7987.02	38325.70	36775.28	7986.69	38325.81	36775.38	7986.76	1/2" rebar w/cap
7	38331.28	36827.08	7949.99	38331.37	36827.10	7950.15	38331.43	36827.41	7949.84	38331.40	36827.89	7949.51	38331.51	36828.21	7949.29	38331.47	36828.18	7949.33	1/2" rebar w/cap
8	38313.55	36858.96	7935.33	38313.53	36858.92	7935.29	38313.75	36859.28	7935.07	38313.54	36859.72	7934.72	38313.63	36859.97	7934.48	38313.59	36860.02	7934.71	1/2" rebar w/cap
9	38319.30	36949.35	7883.24	38319.22	36949.28	7883.21	38319.37	36949.70	7883.16	38319.39	36950.18	7882.75	38319.46	36950.41	7882.55	38319.43	36950.43	7882.60	1/2" rebar w/cap
10	38440.86	36972.65	7844.41	38440.87	36972.67	7844.42	38440.95	36973.01	7844.41	38441.17	36973.49	7844.07	38441.26	36973.76	7843.91	38441.22	36973.78	7843.95	1/2" rebar w/cap
11	38476.43	37003.67	7816.06	38476.50	37003.71	7816.13	38476.43	37003.82	7816.01	38476.58	37004.46	7815.72	38476.71	37004.85	7815.59	38476.71	37004.89	7815.69	1/2" rebar w/cap
12	38509.85	37047.46	7789.87	38509.77	37047.37	7789.84	38509.90	37047.63	7789.75	38510.00	37048.21	7789.46	38510.23	37048.61	7789.39	38510.20	37048.61	7789.45	1/2" rebar w/cap
13	38555.42	37064.56	7771.43	38555.45	37064.60	7771.39	38555.51	37064.70	7771.30	38555.74	37065.31	7771.02	38555.84	37065.72	7770.95	38555.88	37065.72	7771.00	1/2" rebar w/cap
14	38610.87	37099.85	7739.26	38610.90	37099.90	7739.21	38610.90	37099.98	7739.13	38611.04	37100.42	7738.83	38611.26	37100.75	7738.66	38611.31	37100.79	7738.77	1/2" rebar w/cap
30	39908.69	35492.67	8123.71	39908.79	35492.68	8123.68	39908.67	35492.63	8123.62	39908.41	35492.61	8123.32	39908.64	35492.93	8123.12	39908.66	35492.95	8123.05	1/2" rebar w/cap
31	40040.26	35537.78	8074.27	40040.36	35537.75	8074.25	40040.27	35537.64	8074.14	40040.02	35537.59	8073.93	40040.30	35538.21	8073.60	40040.33	35538.25	8073.54	1/2" rebar w/cap
32	40101.53	35681.63	8079.63	40101.61	35681.70	8079.68	40101.53	35681.60	8079.54	40101.25	35681.55	8079.40	40101.64	35682.07	8079.14	40101.64	35682.09	8079.07	1/2" rebar w/cap
33	40180.47	35799.59	8075.64	40180.55	35799.62	8075.62	40180.37	35799.56	8075.47	40180.19	35799.45	8075.33	40180.57	35800.10	8075.22	40180.58	35800.14	8075.13	1/2" rebar w/cap
34	40271.72	35871.88	8066.59	40271.76	35871.89	8066.59	40271.50	35871.81	8066.29	40271.44	35871.72	8066.32	40271.82	35872.32	8066.21	40271.85	35872.35	8066.17	1/2" rebar w/cap
35	40342.59	35936.99	8042.84	40342.59	35937.05	8042.83	40342.42	35936.98	8042.64	40342.22	35936.90	8042.63	40342.62	35937.54	8042.51	40342.66	35937.58	8042.45	1/2" rebar w/cap
36	40401.33	35978.12	8013.00	40401.43	35978.06	8012.93	40401.29	35978.09	8012.85	40401.13	35977.98	8012.73	40401.48	35978.63	8012.60	40401.50	35978.68	8012.57	1/2" rebar w/cap
37	40483.53	36033.85	7961.94	40483.65	36033.83	7961.94	40483.47	36033.73	7961.81	40483.33	36033.65	7961.70	40483.66	36034.36	7961.62	40483.70	36034.44	7961.65	1/2" rebar w/cap
38	40457.48	36107.51	7911.64	40457.59	36107.55	7911.76	40457.46	36107.54	7911.50	40457.31	36107.48	7911.50	40457.65	36108.20	7911.33	40457.74	36108.17	7911.32	1/2" rebar w/cap
39	40384.66	36157.60	7870.68	40384.85	36157.61	7870.78	40384.53	36157.45	7870.28	40384.53	36157.40	7870.42	40384.82	36158.19	7870.35	40384.90	36158.24	7870.35	1/2" rebar w/cap
40	40369.45	36207.99	7835.48	40369.60	36208.01	7835.58	40369.37	36207.98	7835.12	40369.39	36207.89	7835.19	40369.65	36208.67	7835.13	40369.70	36208.64	7835.11	1/2" rebar w/cap
41	40412.36	36328.47	7786.41	40412.52	36328.41	7786.57	40412.33	36328.35	7786.31	40412.05	36328.34	7786.39	40412.32	36328.96	7786.16	40412.30	36328.95	7786.18	1/2" rebar w/cap
42	40486.98	36430.80	7766.77	40487.11	36430.79	7766.91	40486.87	36430.73	7766.64	40486.71	36430.69	7766.67	40486.86	36431.16	7766.58	40486.93	36431.23	7766.61	1/2" rebar w/cap
43	40456.36	36547.60	7739.37	40456.51	36547.56	7739.55	40456.34	36547.59	7739.41	40456.20	36547.44	7739.25	40456.23	36547.80	7739.20	40456.26	36547.82	7739.22	1/2" rebar w/cap
44	40495.04	36677.03	7720.64	40495.16	36676.98	7720.75	40495.05	36676.94	7720.69	40494.76	36676.73	7720.55	40494.91	36676.86	7720.47	40494.89	36676.89	7720.52	1/2" rebar w/cap
45	40539.96	36788.54	7710.28	40540.10	36788.58	7710.37	40539.93	36788.54	7710.27	40539.61	36788.30	7710.25	40539.70	36788.33	7710.16	40539.76	36788.33	7710.17	1/2" rebar w/cap
46	--	--	--	39499.87	35025.50	8431.39	39499.78	35025.57	8431.30	39499.59	35025.41	8431.07	39499.84	35025.94	8430.67	39499.85	35025.91	8430.66	1/2" rebar w/cap
47	--	--	--	39614.25	35140.80	8369.35	39614.13	35140.76	8369.16	39613.90	35140.71	8369.06	39614.14	35141.17	8368.69	39614.16	35141.11	8368.65	1/2" rebar w/cap
48	--	--	--	39708.67	35258.00	8284.45	39708.56	35257.99	8284.30	39708.25	35257.81	8283.96	39708.48	35258.21	8283.58	39708.45	35258.09	8283.50	1/2" rebar w/cap
49	--	--	--	39797.85	35379.02	8203.46	39797.67	35378.99	8203.35	39797.45	35378.99	8203.08	39797.61	35379.42	8202.74	39797.60	35379.34	8202.59	1/2" rebar w/cap

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1344 North 1000 West – Price, UT 84501
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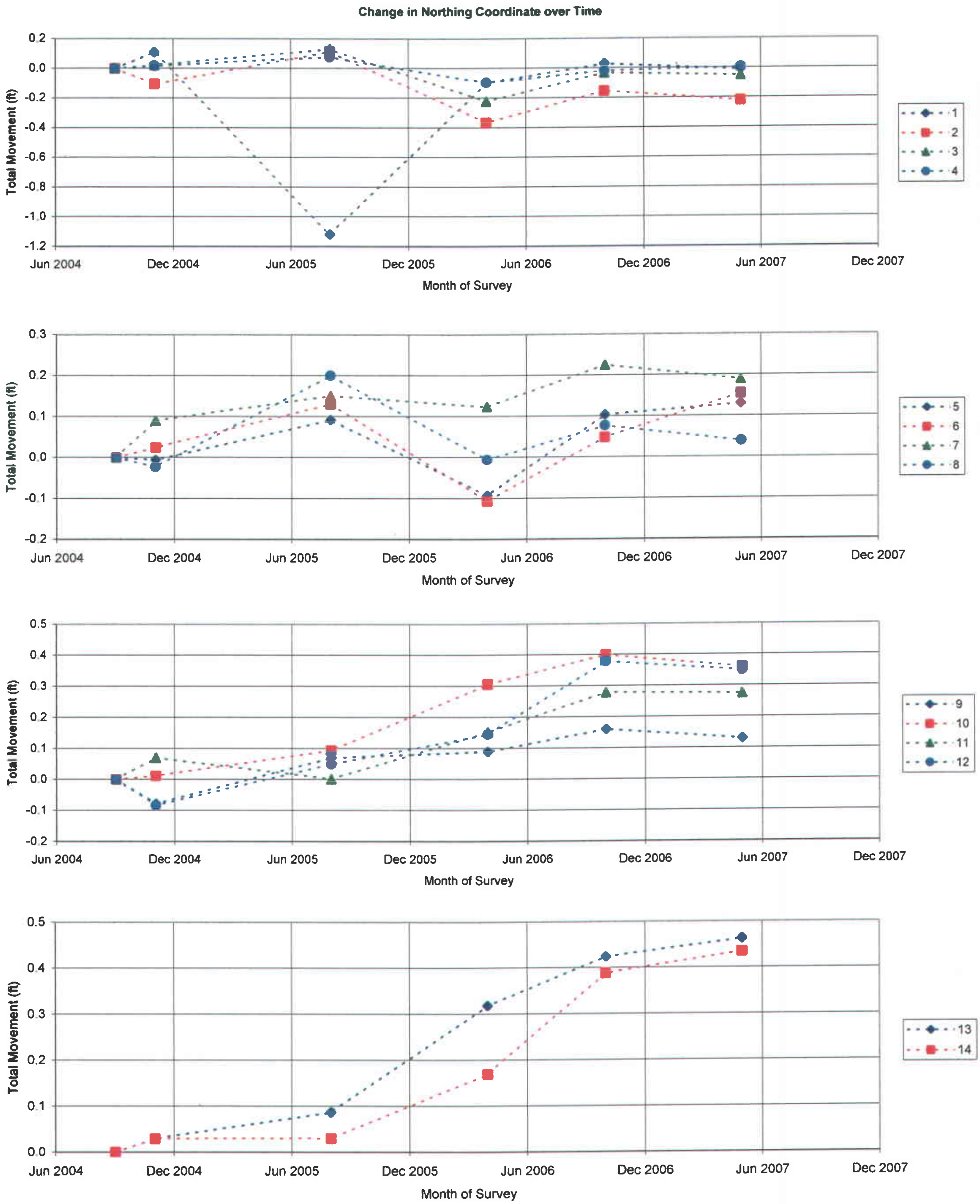

RB&G ENGINEERING INC.
PROVO, UTAH

FIGURE D-2a

POINTS 1-14 - CHANGES IN NORTHING COORDINATES
GRASSY TRAIL DAM AND RESERVOIR - CARBON COUNTY, UTAH

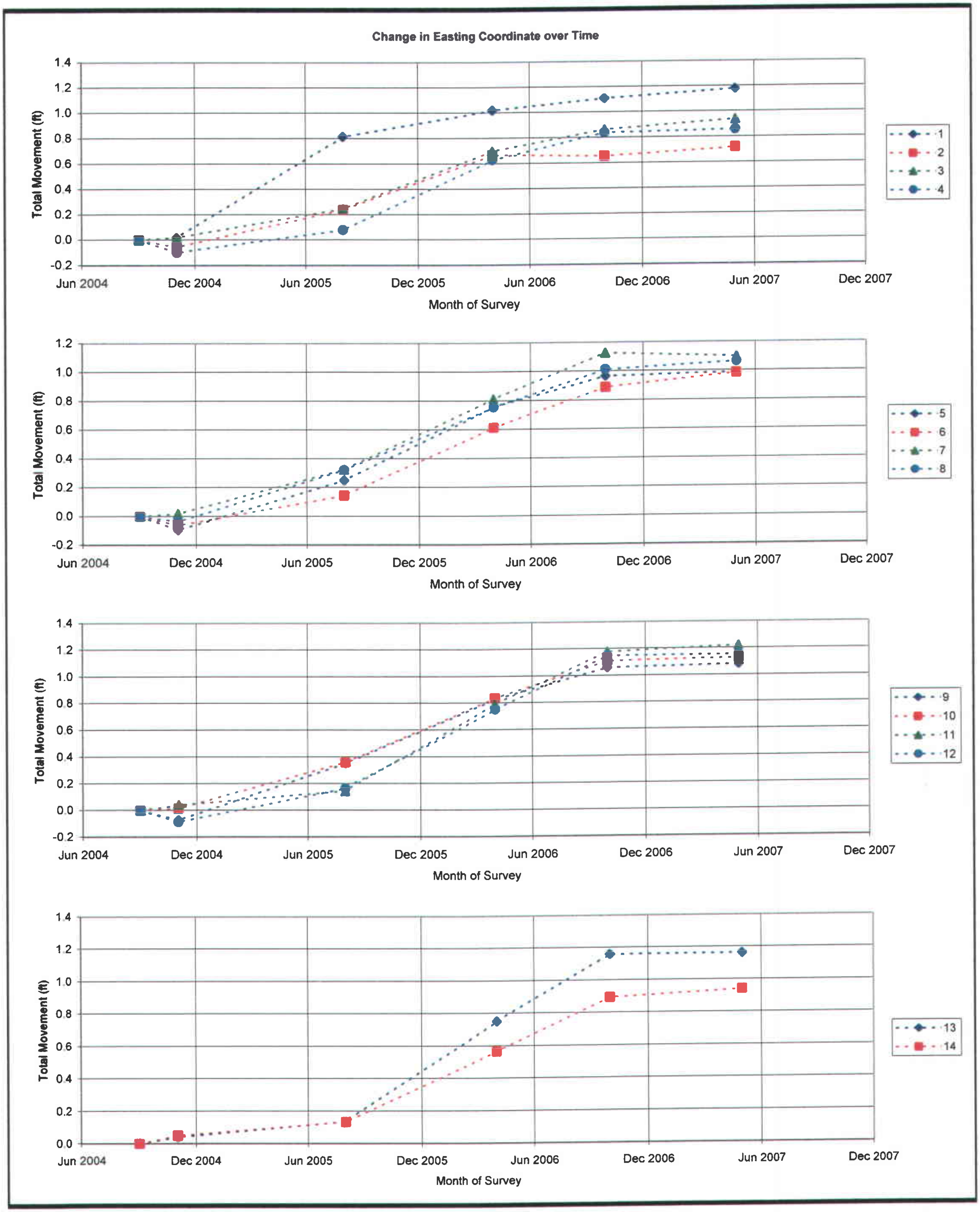

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FIGURE D-2b

POINTS 1-14 - CHANGES IN EASTING COORDINATES
GRASSY TRAIL DAM AND RESERVOIR - CARBON COUNTY, UTAH

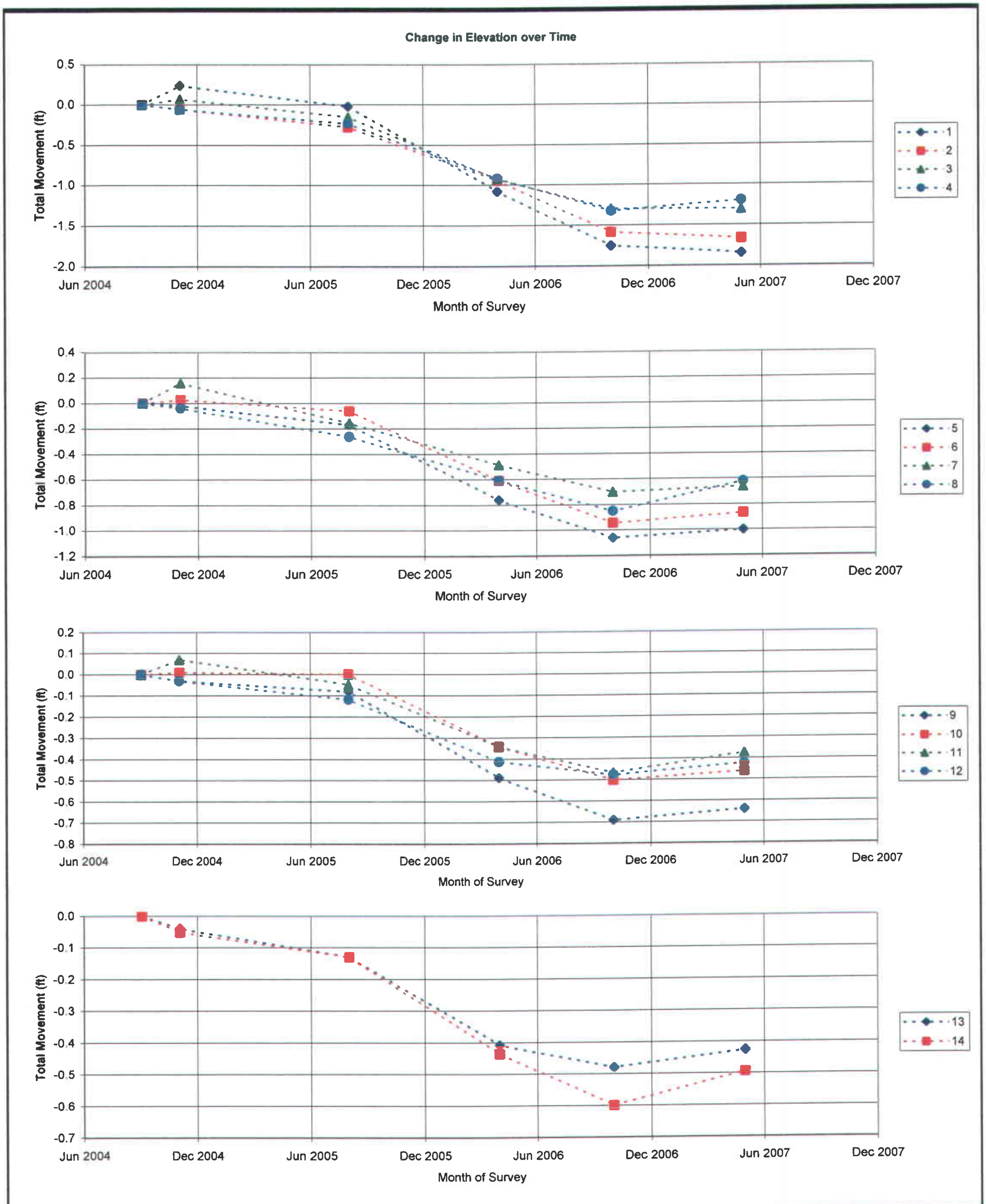

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FIGURE D-2c

POINTS 1-14 - CHANGES IN ELEVATION COORDINATES
GRASSY TRAIL DAM AND RESERVOIR - CARBON COUNTY, UTAH

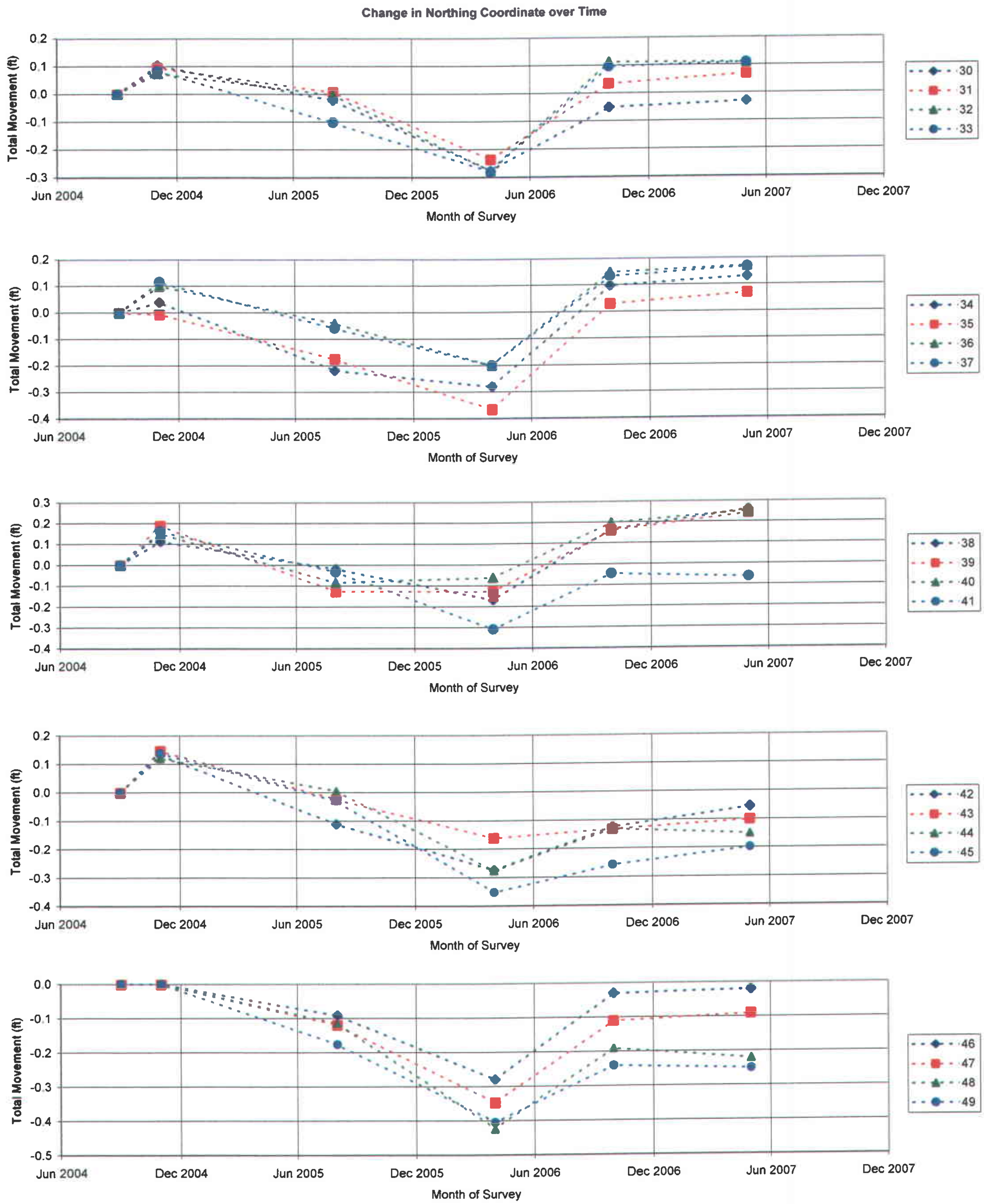

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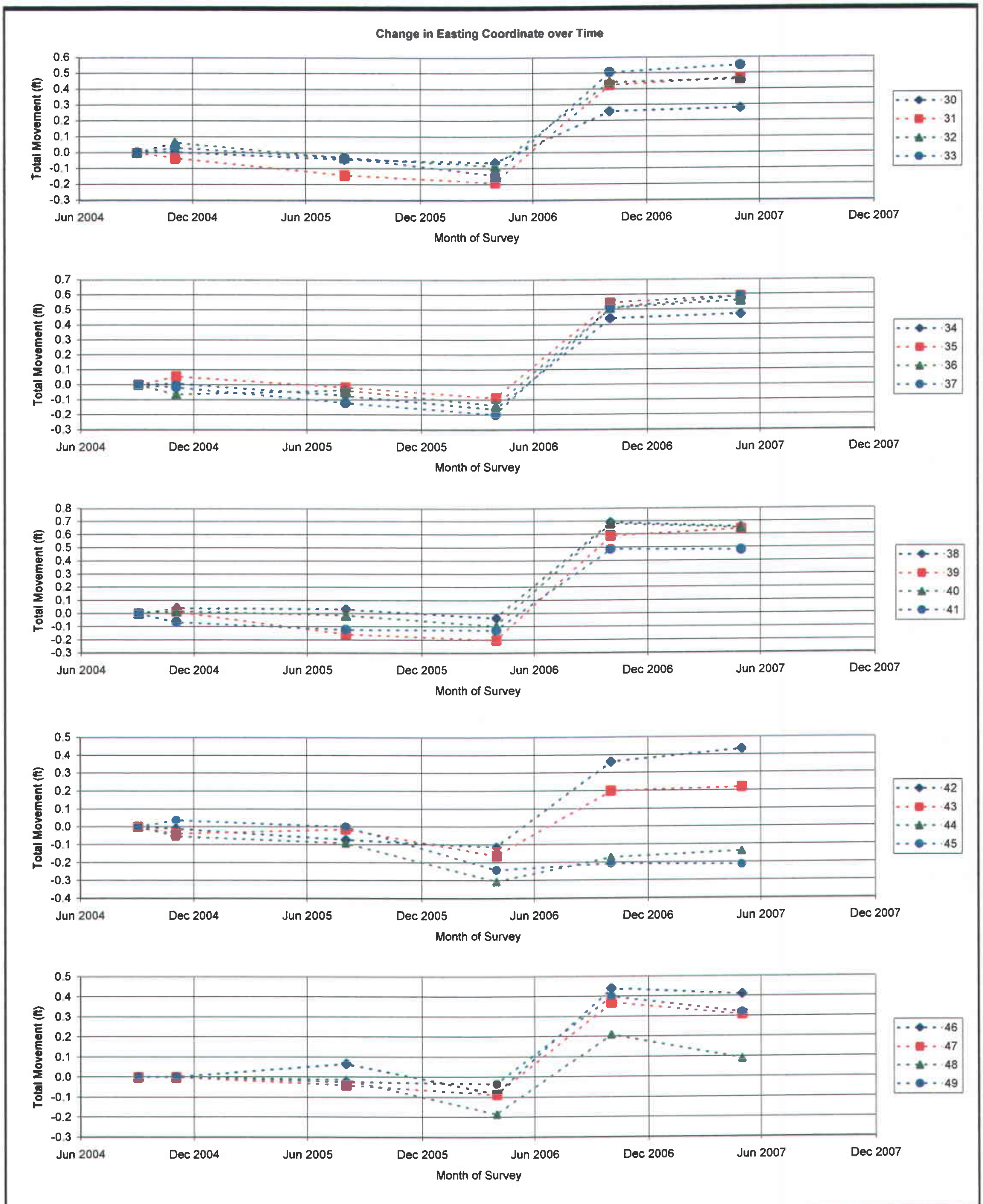
FIGURE D-3a

POINTS 30-49 - CHANGES IN NORTHING COORDINATES
GRASSY TRAIL DAM AND RESERVOIR - CARBON COUNTY, UTAH



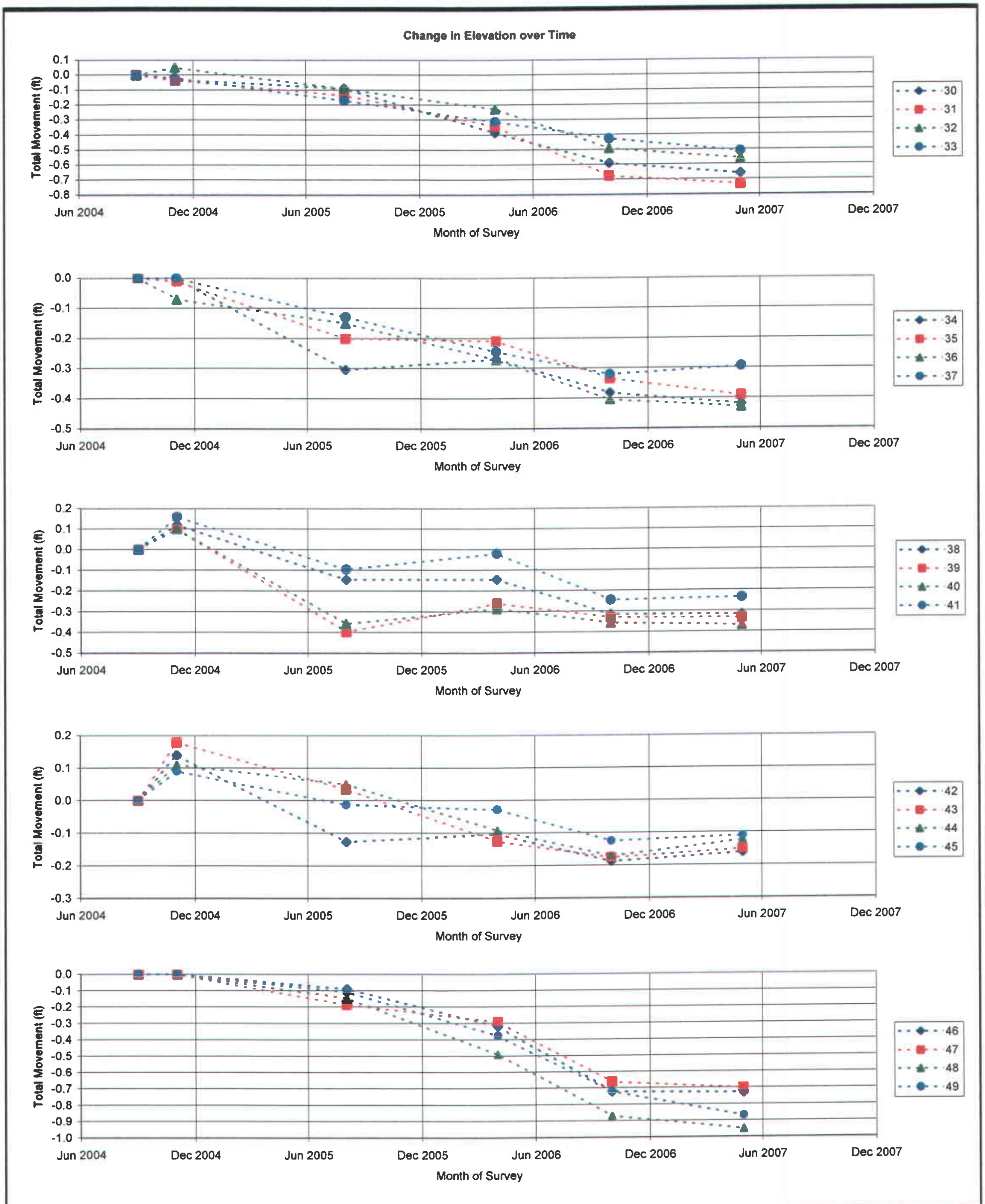
RB&G ENGINEERING INC.

PROVO, UTAH

FIGURE D-3b

POINTS 30-49 - CHANGES IN EASTING COORDINATES

GRASSY TRAIL DAM AND RESERVOIR - CARBON COUNTY, UTAH



RB&G ENGINEERING INC.
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FIGURE D-3c

POINTS 30-49 - CHANGES IN ELEVATION COORDINATES
GRASSY TRAIL DAM AND RESERVOIR - CARBON COUNTY, UTAH

WARE SURVEYING, L.L.C.
1344 North 1000 West – Price, UT 84501
Office: 435-613-1266
Email: waresurveying@emerytelcom.net

August 6, 2007

UtahAmerican Energy
Attn: Dave Shaver

Dear Mr. Shaver,

The purpose of this letter is to document a portion of my involvement with the subsidence monitoring survey of the Grassy Trail Reservoir dam. My company was hired by the West Ridge Mine as a survey consultant to monitor the dam in October of 2005. My monitoring of the dam included GPS, Total Station, and Differential Level observations. In this letter I will summarize the "straight-line" observations that were made at the dam.

In May of 2006 Dave Shaver made the recommendation to perform a "straight-line" observation of a number of points along the surface of the dam. This observation consisted of setting up an optical survey instrument at one end of the dam and setting markers along the dam that are all on the same sight line. Once the marks were set any movement in a direction perpendicular to the sight line would be easily detected. On May 26, 2006 I set the marks along the dam and made the initial or base line survey. At the East end of the dam I pounded a 6-foot long roof bolt (1" diameter solid steel rod) to within 1 foot of the dam surface. I also placed concrete around the roof bolt to a depth of 30 inches. I then set up an optical survey instrument (a Sokkia Set 2 B 2 Total Station) over the roof bolt and sighted a straight line along the dam to the West. On this straight line I was able to line up with a number of the existing monitoring wells that are located along the dam. These wells are square metal tubing that are approximately 4" X 4" and stick out of the ground a couple of feet. I was then able to line up my survey helper who drew a vertical line on 4 of these monitoring wells that were all in a straight line with each other and the roof bolt that I was set up over. Since placing the marks and performing the initial survey I have made 12 subsequent observations of this straight line on the dates shown below. On every survey I set up the same instrument over the roof bolt on the East end of the dam and sighted a straight line to the West along the monitoring well marks. And on every survey all of the marks were on the same East-West sight line, which indicates there was no movement in a North-South direction for the duration of the survey. Beginning on December 14, 2006 we also started measuring distances from the control point on the East end to each of the monitoring wells. These distances were then checked on the subsequent observation dates, and have shown no movement in the East-West direction.

Straight-line survey observation dates:

- May 26, 2006
- May 30, 2006
- June 4, 2006
- June 12, 2006
- June 16, 2006
- June 20, 2006
- June 23, 2006
- June 30, 2006
- July 11, 2006
- July 20, 2006
- August 11, 2006
- September 18, 2006
- October 19, 2006
- December 14, 2006
- January 31, 2007
- March 1, 2007
- March 29, 2007
- May 30, 2007
- June 5, 2007
- July 1, 2007

Sincerely,

M. Cody Ware, PLS

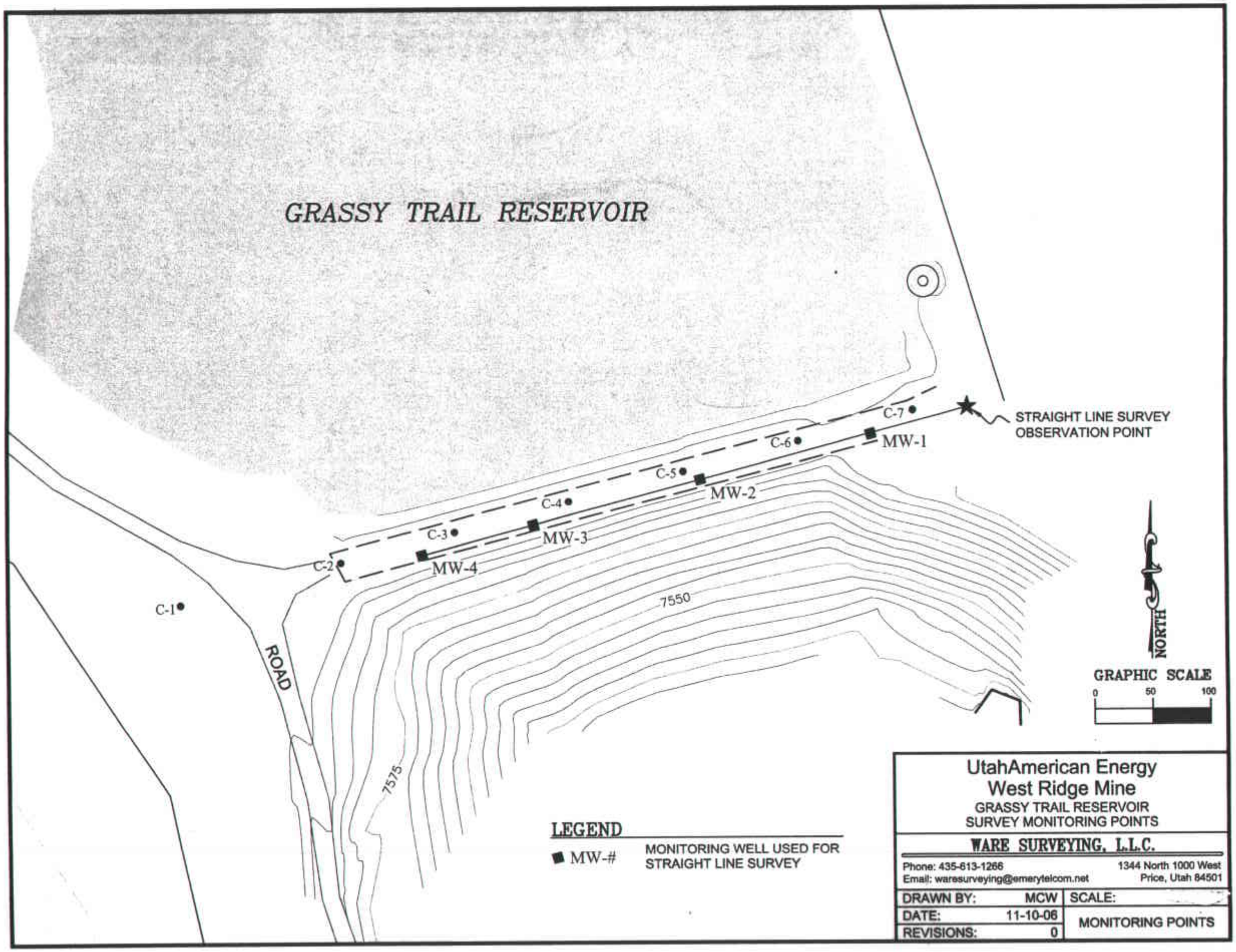

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FIGURE D-4

LOCATIONS OF SURVEY POINTS ON DAM CREST

GRASSY TRAIL DAM - CARBON COUNTY, UTAH

TABLE D-2 SURVEYED DISTANCES ALONG DAM CREST

UtahAmerican Energy
West Ridge Mine
Grassy Trail Reservoir
"Straight line" survey data

8/9/2007

	Distance from control point to face of Monitoring Well (MW) in feet						
STATION	**12/14/2006**	**1/31/2007**	**3/1/2007**	**3/29/2007**	**5/30/2007**	**6/5/2007**	**7/1/2007**
MW-1	94.21	94.21	94.21	94.21	94.20	94.20	94.20
MW-2	141.49	141.49	141.49	141.49	141.49	141.49	141.49
MW-3	245.90	245.90	245.90	245.90	245.89	245.89	245.89
MW-4	295.13	295.13	295.13	295.13	295.12	295.12	295.12
MW-5	394.71	394.71	394.71	394.71	394.70	394.69	394.69
MW-6	493.96	493.96	493.96	493.95	493.94	493.94	493.94
MW-7	556.71	556.71	556.71	556.70	556.70	556.68	556.69
MW-8	708.27	708.27	708.27	708.27	708.26	708.25	708.26
Movement in straight line survey	no	no	no	no	no	no	no

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TABLE D-3 ELEVATIONS OF SETTLEMENT MONITORING POINTS ON DAM CREST

UtahAmerican Energy
West Ridge Mine
Grassy Trail Reservoir
Differential Level survey data

10/16/2007

STATION	C-1	C-2	C-3	C-4	C-5	C-6	C-7
NORTHING	38,830.55	38,865.88	38,892.13	38,917.88	38,943.74	38,969.37	38,996.01
EASTING	37,333.20	37,471.64	37,570.28	37,668.82	37,767.40	37,866.16	37,964.74
Differential level survey date.							
7/30/2002 Elevation	7593.49	7590.63	7590.29	7590.67	7590.44	7590.08	7590.08
8/29/2003 Elevation	7593.50	7590.65	7590.31	7590.69	7590.46	7590.08	7590.08
10/27/2004 Elevation	7593.50	7590.62	7590.30	7590.68	7590.45	7590.08	7590.08
8/12/2005 Elevation	7593.52	7590.66	7590.32	7590.69	7590.46	7590.09	7590.08
3/21/2006 Elevation	7593.50	7590.70	7590.30	7590.68	7590.45	7590.09	7590.08
4/14/2006 Elevation	7593.53	7590.73	7590.31	7590.67	7590.44	7590.08	7590.08
5/4/2006 Elevation	7593.54	7590.75	7590.31	7590.66	7590.43	7590.08	7590.08
5/30/2006 Elevation	7593.55	7590.78	7590.31	7590.65	7590.43	7590.07	7590.08
8/11/2006 Elevation	7593.49	7590.79	7590.31	7590.64	7590.43	7590.07	7590.08
9/18/2006 Elevation	7593.51	7590.82	7590.33	7590.66	7590.43	7590.08	7590.08
10/09/2007 Elevation	7593.54	7590.83	7590.33	7590.67	7590.44	7590.08	7590.08

WARE SURVEYING, L.L.C.
1344 North 1000 West – Price, UT 84501
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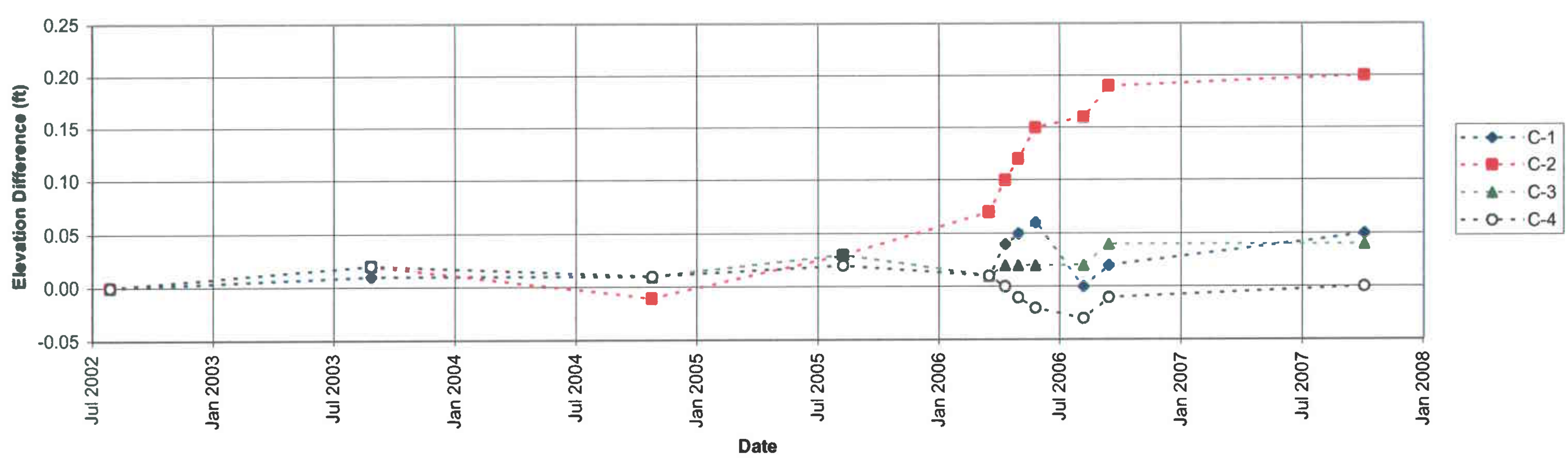

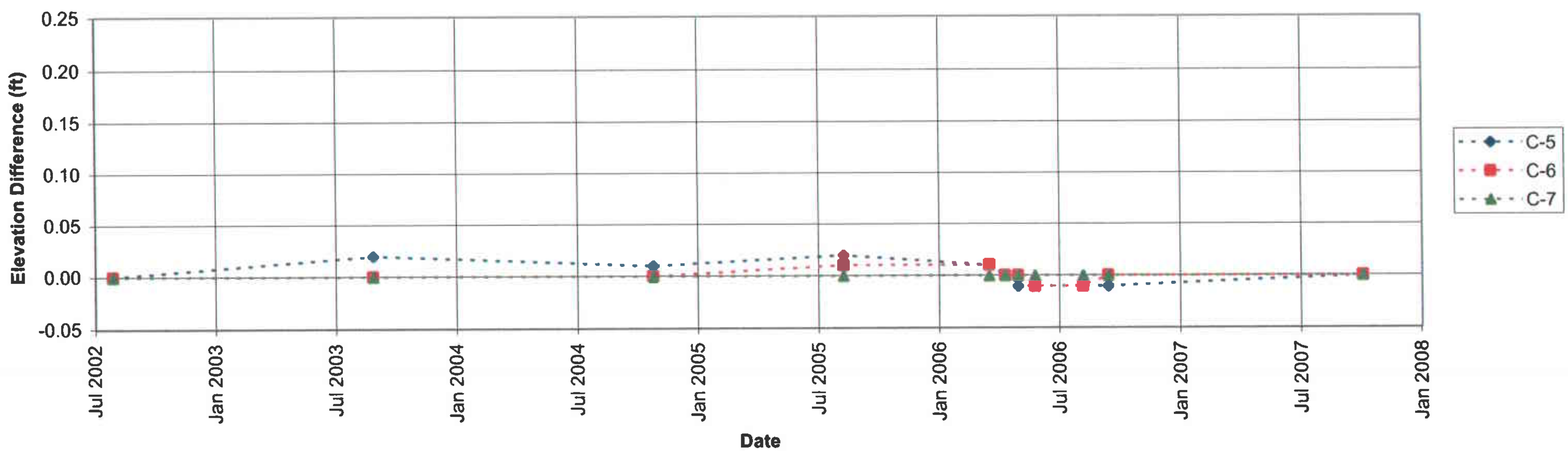

RB&G ENGINEERING INC.

PROVO, UTAH

FIGURE D-5

SURVEY POINTS ON DAM - CHANGE IN ELEVATION VERSUS TIME

GRASSY TRAIL DAM - CARBON COUNTY, UTAH

Appendix E

RB&G Engineering, Inc.

Memo

To: Bret Dixon, Utah Dam Safety

Dave Shaver, West Ridge Resources

From: Brad Price

Date: December 4, 2006

Re: Monitoring Schedule, Grassy Trail Dam & Reservoir

An overview of data obtained to date from instrumentation at Grassy Trail Reservoir was presented at a meeting held November 8, 2006. At this time, the mining operation has moved to another location away from the dam, allowing a reduction in the monitoring frequency for some instrumentation. It was determined at the November 8 meeting that a new monitoring schedule should be established, and that another meeting would be held in approximately six months to re-evaluate the monitoring program. Our recommendations for monitoring during this six-month time period are summarized below.

Accelerometers

Based on the present rate of activity being recorded by the accelerometers, the memory of these devices does not need to be cleared more frequently than once per month. Under the present conditions, it is our opinion that monthly monitoring of the accelerometers will provide data on a sufficiently frequent basis during the next six months.

Inclinometers

It is our opinion that inclinometers should be monitored once a month during the next six months. These devices can be monitored during the same monthly site visit required to obtain accelerometer data.

Piezometers and Drains

We recommend that water elevations in piezometers and seepage flow from drains be recorded on a weekly basis during the next six months. The dam should also be visually inspected during this weekly visit. Care should be taken to note any new cracking, slumping, seepage, or other irregularities on the dam and surrounding slopes – particularly in the vicinity of the right (west) abutment. As agreed upon at the meeting, an additional piezometer will be installed near the right (west) abutment.

Survey Points

At the meeting, Dave Shaver indicated that West Ridge Resources will provide a monthly survey of subsidence monitoring points located on the dam. The basis for the survey will be a point located on the left (east) abutment, which is assumed to be stationary based on monitoring performed to date. The survey accuracy should be ± 0.01 foot vertical and ± 0.02 foot horizontal.

EXHIBIT E-1 – PAGE 2 OF 2

Monitoring of Events Reported by University of Utah Seismic Station (UUSS)

It was agreed at the November 8 meeting that daily reviews of the UUSS web site should continue through the next six months. The threshold criteria used to trigger an immediate site visit will remain in effect. If an event of magnitude greater than 3.0 is reported within 5 miles of the dam, thorough site reconnaissance and reading of accelerometer data will be performed within 24 hours. Reading of all other instrumentation will be performed if any recorded ground acceleration exceeds 0.2g.

Under the anticipated conditions, the proposed schedule of monitoring frequencies and responsibilities is summarized on the table below. The recommended frequency may be changed at any time if instrumentation readings, visual observations, or any other factor indicates that this program is insufficient.

ITEM(S) TO BE MONITORED	MONITORING FREQUENCY	MONITORING RESPONSIBILITY	FREQUENCY OF DATA DISTRIBUTION*
Accelerometers, Inclinometers, & Reconnaissance by Geologist/Engineer	Monthly	RB&G Engineering	Monthly
Piezometers, Drains, and Visual Inspections	Weekly	East Carbon City (forward data to RB&G weekly)	Monthly
Survey Points	Monthly	West Ridge Resources	Monthly
UUSS Website	Daily	RB&G Engineering	Monthly

*Data to be distributed monthly to persons on the list below. Any unusual readings or observations should be reported to the group immediately.

DISTRIBUTION LIST – GRASSY TRAIL RESERVOIR MONITORING INFORMATION			
Name	**Organization**	**Telephone**	**email**
Blake, John	Trust Lands	801-538-5152	jblake@utah.gov
Brinton, Peter	BLM / USO	801-539-4162	Peter_Brinton@blm.gov
Dixon, Bret	Utah Dam Safety	801-538-7373	bretdixon@utah.gov
Faddies, Tom	SITLA	801-538-5150	tomfaddies@utah.gov
Falk, Stephen	BLM – Price	435-636-3605	Steve_Falk@blm.gov
Fluke, Steve	DOGM	801-538-5259	stevefluke@utah.gov
Grubaugh-Littig, Pam	DOGM	801-538-5268	pamgrubaughlittig@utah.gov
Hansen, Michael	RB&G Engineering	801-374-5771	mhansen@rbgengineering.com
Hedberg, Wayne	DOGM	801-538-5286	waynehedberg@utah.gov
Hess, Pete	DOGM – Price	435 613-1146 x203	petehess@utah.gov
Houskeeper, Karl	DOGM – Price	435-613-1146 x201	karlhouskeeper@utah.gov
Hudson, Gregg	BLM / USO	801-539-4040	Gregg_Hudson@blm.gov
Kohler, James	BLM / USO	801-539-4037	James_Kohler@blm.gov
Llewelyn, Jason	Carbon Co. Emerg. Services	435-636-3251	jllewelyn@co.carbon.ut.us
Marble, Dave	Utah Dam Safety	801-538-7376	davemarble@utah.gov
McKenzie, Jeff	BLM / USO	801-539-4038	Jeff_McKenzie@blm.gov
Perkes, Stan	BLM / USO	801-539-4036	Stan_Perkes@blm.gov
Price, Brad	RB&G Engineering	801-374-5771	bprice@rbgengineering.com
Rigby, Steve	BLM / FS – Price	435-636-3604	steve_rigby@blm.gov
Shaver, Dave	West Ridge Resources	435-888-4017	dshaver@utahamerican.com
Stilson, Marc	Water Rights – Price	435-637-1303	marcstilson@utah.gov
Western, Wayne	DOGM	801-538-5263	waynewestern@utah.gov
Wood, Larry	East Carbon City	435-888-6613	ecc@emerytelcom.net
	Sunnyside City	435-888-4444	sunny1@emerytelcom.net

RB&G
ENGINEERING, INC.

1435 W 820 N
Provo, UT, 84601
Phone: 801-374-5771
Fax: 801-374-5773

Memo

To: Bret Dixon, Utah Dam Safety
Dave Shaver, West Ridge Resources

From: Brad Price, Rob Johnson

Date: November 14, 2007

Re: Updated Monitoring Schedule, Grassy Trail Dam & Reservoir

---

An overview of data obtained in the past year from instrumentation at Grassy Trail Reservoir was presented at a meeting held October 25, 2007. It was noted that very few mining-induced seismic events had been detected near the dam since mining of Panel 7 was completed. Ground movements detected at settlement points and inclinometers in the past year have lessened dramatically; however, it appears that very slight movements may be ongoing. It was determined at the October 25 meeting that the monitoring program should generally continue as it has over the past year; with some slight modifications. The revised monitoring program, to be adopted until further notice, is as follows.

Accelerometers

Under the present conditions, the accelerometers should be monitored on a monthly basis to ensure that they are working properly and to upload the records of any new events that occur. The hillside instrument requires recalibration at this time. As agreed at the meeting, we will send this instrument to the manufacturer for recalibration at the expense of the mine.

Inclinometers

Based on discussion at the meeting, and subsequent correspondence/discussion, we (RB&G Engineering) will visit the site to take inclinometer readings one each month until further notice. Inclinometer No. 4, located on the west rim of the reservoir, was damaged by a contractor working for Questar Gas Company. We received a phone call from Tim Blackham of Questar the week of October 29. 2007, who expressed the willingness of Questar and their contractor to pay for and participate in any repairs needed. Repair of this device is currently in progress.

Piezometers and Drains

The dam's owners (East Carbon City and Sunnyside City) will continue to take responsibility for these items. It was agreed at the meeting that water levels in the piezometers may now be measured every two weeks. Site visits to visually inspect the dam and record drain flows should continue on a weekly basis. Care should be taken to note any new cracking, slumping, seepage, discolored flow from drains, or other irregularities on the dam and surrounding slopes – particularly in the vicinity of the right (west) abutment.

Survey Points

The survey of points on the dam will continue to be the responsibility of the mine. Surveys will continue to be conducted at monthly intervals. The survey should provide horizontal and vertical coordinates for the monuments at the crest, mid-slope, and toe of the dam. The basis for the survey will be a point located on the left (east) abutment, which is assumed to be stationary based on monitoring performed to date. The survey accuracy should be ± 0.01 foot vertical and ± 0.02 foot horizontal.

Monitoring of Events Reported by University of Utah Seismic Station (UUSS)

RB&G Engineering will continue to perform daily reviews of the UUSS web site. The threshold criteria used to trigger an immediate site visit will remain in effect. If an event of magnitude greater than 3.0 is reported within 5 miles of the dam, thorough site reconnaissance and reading of accelerometer data will be performed within 24 hours. Reading of all other instrumentation will be performed if any recorded ground acceleration exceeds 0.2g.

Under the anticipated conditions, the proposed schedule of monitoring frequencies and responsibilities is summarized on the table below. The recommended frequency may be changed at any time if instrumentation readings, visual observations, or any other factor indicates that this program is insufficient.

ITEM(S) TO BE MONITORED	MONITORING FREQUENCY	MONITORING RESPONSIBILITY	FREQUENCY OF DATA DISTRIBUTION*
Inclinometers, & Reconnaissance by Geologist/Engineer	Monthly	RB&G Engineering	Monthly
Accelerometers	Monthly	RB&G Engineering	Monthly
Drains & Visual Inspections	Weekly	East Carbon City (forward data to RB&G weekly)	Monthly
Piezometers	Bi-Weekly	East Carbon City	Monthly
Survey Points	Monthly	West Ridge Resources	Monthly
UUSS Website	Daily	RB&G Engineering	Monthly

*Data to be distributed to those listed below. Any unusual readings or observations to be reported to the group immediately.

DISTRIBUTION LIST – GRASSY TRAIL RESERVOIR MONITORING INFORMATION			
Name	**Organization**	**Telephone**	**email**
** Andrews, Bruce	Sunnyside City	435-888-4444	sunny1@emerytelcom.net
Blake, John	Trust Lands	801-538-5152	jblake@utah.gov
Brinton, Peter	BLM / USO	801-539-4162	Peter_Brinton@blm.gov
** Dean, Dana	DOGM	801-538-5259	danadean@utah.gov
Dixon, Bret	Utah Dam Safety	801-538-7373	bretdixon@utah.gov
Faddies, Tom	SITLA	801-538-5150	tomfaddies@utah.gov
Falk, Stephen	BLM – Price	435-636-3605	Steve_Falk@blm.gov
Grubaugh-Littig, Pam	DOGM	801-538-5268	pamgrubaughlittig@utah.gov
Hansen, Michael	RB&G Engineering	801-374-5771	mhansen@rbgengineering.com
Hedberg, Wayne	DOGM	801-538-5286	waynehedberg@utah.gov
Hess, Pete	DOGM – Price	435 613-1146 x203	petehess@utah.gov
Houskeeper, Karl	DOGM – Price	435-613-1146 x201	karlhouskeeper@utah.gov
Hudson, Gregg	BLM / USO	801-539-4040	Gregg_Hudson@blm.gov
Kohler, James	BLM / USO	801-539-4037	James_Kohler@blm.gov
** LaFontaine, Orlando	East Carbon City	435-888-6613	ecc@emerytelcom.net
Llewelyn, Jason	Carbon Co. Emerg. Services	435-636-3251	jllewelyn@co.carbon.ut.us
Marble, Dave	Utah Dam Safety	801-538-7376	davemarble@utah.gov
McKenzie, Jeff	BLM / USO	801-539-4038	Jeff_McKenzie@blm.gov
Perkes, Stan	BLM / USO	801-539-4036	Stan_Perkes@blm.gov
Price, Brad	RB&G Engineering	801-374-5771	bprice@rbgengineering.com
Rigby, Steve	BLM / FS – Price	435-636-3604	steve_rigby@blm.gov
Shaver, Dave	West Ridge Resources	435-888-4017	dshaver@coalsource.com
Stilson, Marc	Water Rights – Price	435-637-1303	marcstilson@utah.gov
Western, Wayne	DOGM	801-538-5263	waynewestern@utah.gov

** Names changed or added since the previous list dated December 4, 2006.